09/842,525

L Number	Hits	Search Text	DB	Time stamp
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Freeform Search

Database: US Pre-Grant Publication Full-Text Database; US Patents Full-Text Database; US OCR Full-Text Database; EPO Abstracts Database; JPO Abstracts Database; Derwent World Patents Index; IBM Technical Disclosure Bulletins

Term: L7 and convert$

Display: 50 **Documents in Display Format:** - **Starting with Number** 1

Generate: ○ Hit List ◉ Hit Count ○ Side by Side ○ Image

Search | Clear | Interrupt

Search History

DATE: Wednesday, June 02, 2004 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=OR			
L10	L9 and (medical near format)	1	L10
L9	L7 and convert$	20	L9
L8	L7 and (medical near format)	1	L8
L7	L6 and (medical near image)	48	L7
L6	L5 and (image near database)	571	L6
L5	707/$.ccls.	20691	L5
L4	L3 and convert$	14	L4
L3	L2 and (image near format)	23	L3
L2	L1 and (707/$.ccls.)	122	L2
L1	medical near image	7302	L1

END OF SEARCH HISTORY

L4: Entry 10 of 14 File: USPT Jan 13, 2004

DOCUMENT-IDENTIFIER: US 6678764 B2
TITLE: Medical image processing system

Abstract Text (1):
A medical image archiving system and method. A medical image archiving system receives analog NTSC or PAL video from a medical imaging device and converts it to a digital format for storage. The storage can be via local hard disc drive, or CD writer, or other optical storage medium, or via Local or Wide area network storage to a remote electronic storage medium. The system includes an integral web server to permit easy access over a network using a browser. When an image is stored on a CD, it can be stored as a session and the CD closed to prevent further writing.

Brief Summary Text (2):
This invention relates generally to medical image systems, and more particularly to a medical image archiving and information exchange system, with image management features.

Brief Summary Text (8):
In one embodiment of the present invention, a medical image archiving system and method is provided. A medical image archiving system receives analog NTSC or PAL video from a medical imaging device and converts it to a digital format for storage. The storage can be via local hard disc drive, or CD writer, or other optical storage medium, or via Local or Wide area network storage to a remote electronic storage medium. The system includes an integral web server to permit easy access over a network using a browser. When an image is stored on a CD, it can be stored as a session and the CD closed to prevent further writing.

Brief Summary Text (9):
A medical imaging method consistent with an embodiment of the present invention includes receiving an analog video input signal from a medical imaging device; converting a frame of the analog video input signal to a digital representation; assigning a file name to the digital representation; storing the digital representation on a disc drive; and storing the digital representation as a part of a session on an optical storage medium.

Brief Summary Text (10):
A medical image archiving device, consistent with an embodiment of the present invention includes a frame grabber that receives an analog video image from a medical imaging device and produces a digitized still image in response to a command. A programmed processor is connected to a network interface adapter that interfaces the processor to an electronic communication network. A web server application runs on the programmed processor, the web server having an IP address associated therewith. A disc drive stores the digitized still image. An application program running on the programmed processor receives a request directed to the IP address for the digitized still image from the network via the network interface adapter, and generates a reply transmitting the digitized image to an IP address associated with the request.

Brief Summary Text (11):
A storage medium consistent with an embodiment of the invention stores instructions

which, when executed on a programmed processor, carry out a process of: receiving an analog video input signal from a medical imaging device; converting a frame of the analog video input signal to a digital representation; assigning a file name to the digital representation; storing the digital representation on a disc drive; and storing the digital representation as a part of a session on an optical storage medium. In one variation, the the digital representation is transmitted over either a wide area network or a local area network.

Drawing Description Text (3):
FIG. 1 is a block diagram of a medical image archiving device consistent with an embodiment of the present invention.

Detailed Description Text (3):
Turning now to FIG. 1, a medical image archiving device 100 that can be used as a part of a system to capture video images is illustrated. Once the images are generated in analog form by the medical imaging device, they can be readily converted to digital form by the current medical image archiving device 100 and archived to any suitable local or remote electronic storage medium, transferred to a remote display via a local or wide area network (including the Internet) or printed as required. Operation of the device will be best understood upon consideration of the discussions of the possible system environments to be described later. Device 100 accepts a conventional analog output (e.g., from an ultrasound imaging device) at an interface 104. This interface may receive, for example, NTSC or PAL formatted analog video signals from a medical imaging device such as an ultrasound machine and convert them to a digital format using an analog to digital converter under the control of a processor 108 (e.g., a PC based computer processor having associated memory 112). A digitally encoded still image is made available to a system bus 116 by the hardware or software based frame grabber forming a part of interface 104.

Detailed Description Text (5):
Preferably, the image signal is received at the interface 104 as a conventional (e.g., NTSC or PAL) video signal output by a conventional medical imaging device, such as an ultrasound scanning device or operating room endoscope that displays on a CRT using NTSC standards or the like. Optionally, an RGB or other analog format input may be accommodated. In one embodiment, a MATROX Meteor-II.TM. video capture board, as manufactured by Matrox Electronic Systems, 1055 St. Regis, Dorsal, Quebec, Canada H9P 2T4 may be used to implement the video capture functionality of interface 104. The medical image archiving device 100 captures a still image frame corresponding to the incoming video stream using the frame grabber of interface 104, and then converts the grabbed frame into a digital format under the control of processor 108. Such conversion may take place in the frame grabber interface board 104 or may be carried out by processor 108 under program control. Preferably, the .tif format is used, however, other formats could equally well be used, such as the DICOM (digital imaging and communications in medicine) format without departing from the invention. Depending upon input instructions, the grabbed and formatted image can then be stored on a local hard disc drive 128 (e.g., a 60 GB hard disc drive), recorded on a writable compact disc or the like at 134, printed via printer interface 124, or transmitted to other nodes on any network to which the device is connected via the network interface 140.

Detailed Description Text (8):
The medical image archiving device 100 uses an embedded PC based on processor 108 as a control processor to provide the following functionality. The medical image archiving device 100 receives an analog signal from the image capture device 204, stores the image in digital form at the internal hard disc drive 128 (perhaps temporarily) and outputs corresponding digital signals to the media writer 134 and the printer 210. The medical image archiving device 100 also receives image capturing and storing commands, preferably from a simplified foot operated device such as a three button serial footswitch 220, but may instead or in addition to the

footswitch 220 utilize a keyboard and/or a display device, or hand held terminal 212 to facilitate input. Utilizing this functionality, the medical image archiving device 100 permits the user to capture the images (e.g., ultrasound images), print them using a high quality printer 210, record the images on a non-volatile storage medium such as a CD-R or DVD to facilitate organization, management and archiving of the images. Preferably, images stored on a CD are stored as a session with the CD being closed after writing the session to prevent further writing on the CD.

Detailed Description Text (11):
Referring now to FIG. 3, an exemplary system 300 is illustrated using a hospital LAN 304 used to network a plurality of medical image archiving systems 100A, 100B and 100C connected to various client terminal devices 306 and as well as a server 310 serving as a repository for a database of medical records 316. In such a system, medical records can be centrally stored in server 310's database 316 with input from any of the medical image archiving devices 100A, 100B and 100C periodically contributing to the storehouse of information. Any of this information may be retrieved at any time from a client workstation 306 or other appropriately connected viewing device connected to the LAN 304 for immediate access to the information. In this manner, consulting physicians can view images from their office, a library or any other convenient location having access to the hospital LAN 304 to provide more rapid and efficient viewing. Since the medical image archiving devices each incorporate the software that implements a web server, each has an IP address that can be used from any terminal to access the data stored on the disc drive 128 thereof using any suitable browser software.

Detailed Description Text (12):
FIG. 4 illustrates a third exemplary system consistent with an embodiment of the present invention, in which the hospital server 310 is connected via a gateway 402 to a records managing server 404 having a medical records database 406 through a public or private network 410 such as the Internet. In this embodiment, preferably, the hospital LAN 304 implements a web server. Pictures stored on the image archiving device hard disc drive 128 can be reviewed remotely via a TCP/IP connection, using a regular browser. Thus, an expert physician, technician or researcher in another city can be provided with access to view a particular patient's images (either on the local database 316 or on the medical image archiving devices 100A or 100B) without need for delays associated with mailing hard copy records for review. Security software 154, such as that commercially available from Verisign, 1350 Charleston Road, Mountain View, Calif. 94043 or others can be used to control access to the images. Pictures can be automatically downloaded and stored at the remotely located medical records management server 404 during evening hours or the like, before freeing the local storage as described above.

Detailed Description Text (13):
Additionally, the embodiment of FIG. 4 provides an easy way to dynamically setup the image archiving device 100. The settings for the device can be made directly upon set up, using the optional keyboard/LCD. Alternatively, the settings can be remotely provided at the hospital server 310, client node 306 or any other appropriate node, using a browser based interface, such as the commercially available Netscape Navigator.TM., from Netscape, 466 Ellis Street, Mountain View, Calif. 94043 or other browser software. The selectable settings in this embodiment include IP address, hospital/practice name, and storage length, and backup characteristics. Preferably, the medical image archiving device also includes a non-volatile flash memory forming a part of memory 112 that stores settings information. In addition to initialization, maintenance can be performed remotely via the network or the web.

Detailed Description Text (25):
The captured .tif or DICOM (or other format) images may be variously manipulated for printing, preferably to provide 1, 4, 6 or 9 image prints per page. One

preferred printer is the Sony.TM. UP-D70XR photo-realistic printer--available commercially from Sony Corporation, Tokyo, Japan, which provides full letter-sized printing capabilities for various medical and scientific applications. The UP-D70XR includes a 300 dpi thermal head that prints in color images in approximately 55 seconds and transparency images in approximately 45 seconds. A gray balance calibrating function allows users to set the ideal gray balance for color accurate images. The print area covers up to 8".times.10" on letter-size paper and full-bleed on A4+paper. The UP-D70XR includes SCSI and Centronics interface for connection to the image archiving device. For DICOM format, the UPA-D3 Digital Print Server can be used with this printer, and can communicate with the printer over the hospital LAN using TCP/IP. Of course, any suitable printer can be used without departing from the present invention.

Detailed Description Text (27):
In the network environment, with the browser based functionality as described above, various records can be easily accessed and managed, and the records can further be organized according to the above described syntax. That is, the records for a given doctor could be browsed, and HTML links to the individual files, for remote viewing, downloading and the like are readily provided. By virtue of the medical image archiving device being equipped with a web server, the device can be addressed by its IP address, queried to request a stored image, and transmit the stored image to an IP address associated with the request.

Detailed Description Text (29):
Referring now to FIG. 6, an exemplary hand held terminal is illustrated. The terminal includes a small display 604 (e.g., an LCD display panel) with large enough resolution to permit display of all needed prompts and user inputs. Scrolling can be used if needed to facilitate display of prompts and user input. An array of input keys such as alpha-numeric key 608 is also provided to permit entry of text and numerical data. In one embodiment, specific function keys such as a "print" key 614 and a "grab" key 616 may be provided. In other embodiment, generic function keys (F1, F2, . . .) are used. The hand held terminal 212 may be connected to the medical image archiving device 100 by a cable 612 or using infrared or other communications as will be evident to those skilled in the art. The specific keyboard layout shown is intended only to be exemplary and should not be considered limiting. Other terminal configurations can also be used.

Detailed Description Text (30):
FIG. 7 shows an exemplary setup screen used in the preferred embodiment of the invention. In this screen, various default and system parameters are entered and stored in flash memory, or other non-volatile storage for use by the device 100. When the medical image archiving device 100 is turned on for the first time, or when a specified command is issued to initiate a setup, a setup screen such as screen 700 appears. Screen 700 is created, in one embodiment, using HTML and is displayed using a browser. In a network embodiment, the setup screen can be displayed and completed from a remote terminal device such as 306. In this screen 700, the user can enter the number of prints per page (in this embodiment 2.times.2 or 2.times.3) and the type of video format being received. The user also selects the type of display (color or monochrome) and the input port being used (composite or S-Video).

Current US Cross Reference Classification (3):
707/10

CLAIMS:

1. A medical imaging method in a medical image archiving device, comprising:
sending a prompt for image identification information to a hand held terminal;
receiving the image identification information from the hand held terminal;
receiving a grab image command from one of a footswitch and the hand held terminal;

receiving an analog video input signal from a medical imaging device; converting a frame of the analog video input signal to a digital representation within the image archiving device in response to receiving the grab image command from one of the footswitch and the hand held terminal; receiving a store image command from one of the footswitch and the hand held terminal; assigning a file name to the digital representation based on the image identification information; storing the digital representation on a disc drive; receiving a burn CD command from one of the footswitch and the hand held terminal: and storing the digital representation as a part of a session on an optical storage medium.

10. A medical image archiving system, comprising: a footswitch; a hand held terminal; and a medical image archiving device, comprising: an interface for attaching the footswitch; an interface for attaching the hand held terminal; a frame grabber receiving an analog video image from a medical imaging device and producing a digitized still image in response to a grab image command from one of the footswitch and the hand held terminal; a programmed processor; a network interface adapter that interfaces the processor to an electronic communication network; a web server application running on the programmed processor, the web server having an IP address associated therewith; a disc drive that stores the digitized still image in response to a store image command received from one of the footswitch and the hand held terminal; an application program running on the programmed processor that receives a request directed to the IP address for the digitized still image from the network via the network interface adapter, and generates a reply transmitting the digitized image to an IP address associated with the request.

20. A storage medium storing instructions which, when executed on a programmed processor in a medical image archiving device, carry out a process of: sending a prompt for image identification information to a hand held terminal; receiving the image identification information from the hand held terminal; receiving a grab image command from one of a footswitch and the hand held terminal; receiving an analog video input signal from a medical imaging device; converting a frame of the analog video input signal to a digital representation within the image archiving device in response to receiving the grab image command from one of the footswitch and hand held terminal; receiving a store image command from one of the footswitch and the hand held terminal; assigning a file name to the digital representation based on the image identification information; storing the digital representation on a disc drive; receiving a burn CD command from one of the footswitch and the hand held terminal; and storing the digital representation as a part of a session on an optical storage medium.

L4: Entry 13 of 14 File: USPT Jul 10, 2001

DOCUMENT-IDENTIFIER: US 6260021 B1
TITLE: Computer-based medical image distribution system and method

Abstract Text (1):
This invention relates to an object-oriented system and method for easily and rapidly distributing medical images from existing picture and report storage systems to a plurality of heterogeneous client workstations. The system includes one or more interface engines, for providing image objects with uniform structure regardless of the type of existing system on which they are stored, and image server middleware, for managing the distribution of image objects. The system also includes a security object server, for authorizing user access to the image distribution system and to particular objects, a personalization object server, for providing user interface preferences and client workstation capabilities, and a web server, for downloading initial access pages and user interface components. The system implements a method for medical image distribution according to which image data stored in existing picture storage systems is first converted into a uniformly structured image objects before being composed for downloading to client workstations for user viewing. The system and method of this invention are easily extensible both for added function and for added performance. The system and method of this invention are preferably implemented according to CORBA standards.

Brief Summary Text (3):
The present invention relates to a computer system and method for enabling uniform access to and ready distribution of medical images and associated records in electronic form via a network, such as an intranet or the Internet, from multiple heterogenous and incompatible existing server systems.

Brief Summary Text (5):
Handling of medical images, and of associated medical information, has been profoundly changed by the impact of digital and computer technologies. But in the current state of the art, these technologies have not resulted in uniform system by which a user can readily access medical image information from multiple and incompatible existing server systems.

Brief Summary Text (7):
Medical images are currently acquired by diverse imaging technologies and methods, including, for example, such methods as X-ray imaging, computed X-ray tomography, radioisotope emission imaging, computed emission tomography, magnetic resonance imaging, ultrasound imaging, and so forth. With increasing prevalence, medical images acquired by these and other methods are being directly acquired in or converted into digital form for storage and retrieval.

Brief Summary Text (8):
Current computer systems for storage and retrieval of such digital medical images (generically named Picture Archiving and Communication, or "PAC", systems), typically have large amounts of digital storage, a processor for storing and indexing images, and user workstations attached directly, or across a network, to the PAC systems for image display. These systems have usually been designed with a client-server, or two-tiered, structures. In such structures, the workstations, acting on the second-tier as image clients, run specific software designed for

interacting with a specific PAC system, acting on the first tier as an image server, in order to obtain and display images. The specific server software on the PAC system is designed to accept and respond only to the specific requests from the corresponding image-clients.

Brief Summary Text (10):
Similarly text interpreting medical image and associated patient information is being transcribed into or captured directly in digital form and stored on server systems (generically named Radiology Information, or "RI", systems). RI systems, like PAC systems, are also usually designed as client-server, or two-tiered, systems with user workstations running specific client software that interacts only with specific server software on the RI system.

Brief Summary Text (15):
One approach to solving these incompatibilities is standardization of messages or interfaces. However, standardization alone is at best only a partial solution to solving system incompatibilities and to providing uniform data access. For example, the Digital Imaging and Communications in Medicine ("DICOM") is one standard relevant to medical image distribution. DICOM has been developed and promoted by the American College of Radiology/National Equipment Manufacturers Association (ACR/NEMA), and aims to standardize formats for exchange of image data in PAC systems by defining a standard set of basic and composite data types along with a standard set of requests involving those data types, all of which are representative of the imaging activities in a radiology department. Accordingly, a single workstation with a DICOM-conforming client can expect some success in accessing multiple PAC systems, also DICOM-conforming, and the multiple DICOM-conforming PAC systems can themselves expect some success in exchanging image data. Individual variations in the details of DICOM-conformance may defeat interoperability or data interchange.

Brief Summary Text (18):
Therefore, the current state of the art in medical image distribution faces daunting problems due to a lack of uniform access to and interchange of medical images stored in various different PAC systems, and also to a lack of uniform access to and interchange of associated medical interpretive text information stored in RI and other health-care systems.

Brief Summary Text (19):
What is needed, therefore, is a method and system by which a user can uniformly and rapidly access medical image data without regard to the boundaries of existing PAC, RI, or other health-care systems. Further, since health-care personal often do not have fixed work locations, needing to respond to health-care problems promptly wherever they happen to be, such uniform and rapid access should allow users to access medical image information from many diverse local or remote workstations. And since patients also move, such uniform access should provide medical image information between separate health-care institutions.

Brief Summary Text (22):
The middleware software of the present invention which processes data and requests to existing PAC and RI systems into a common format and structure. Medical images and associated medical information, and indeed general patient data, can then be made uniformly available to user workstations. A single workstation can access data from a diverse range of prior-art PAC and RI systems by running single client software which need only interact with the provided common format and structure. Further, existing PAC and RI systems can efficiently exchange data through the medium of this common format and structure.

Brief Summary Text (23):
Generally, the system includes one of more interface engines, for providing image objects with uniform structure regardless of the type of existing system on which

they are stored, and image server middleware, for managing the distribution of image objects. The system also includes a security object server, for authorizing user access to the image distribution system and to particular objects, a personalization object server, for providing user interface preferences and client workstation capabilities, and a web server, for downloading initial access pages and user interface components. The system implements a method for medical image distribution according to which image data stored in existing picture storage systems is first converted into a uniformly structured image objects before being composed for downloading to client workstations for user viewing. The system and method of this invention are easily extensible both for added function and for added performance. The system and method of this invention are preferably implemented according to CORBA standards.

Brief Summary Text (24):
In a first embodiment, this invention includes a medical image distribution system for distributing medical images from one or more existing storage systems to a plurality of network-attached client workstations, said medical image distribution system comprising one or more computer systems, and wherein each said network-attached client workstation is configured with an object-oriented graphical interface for receiving medical image requests from a user and for displaying medical image objects to the user; and wherein said one or more computer systems are configured with one or more interface engines, each said interface engine for retrieving medical image data from one or more existing storage systems and for presenting retrieved medical image data as medical image objects with a uniform object-oriented structure, and one or more image object coordinators for receiving medical image requests transmitted from one of said graphical interfaces, for obtaining medical image objects in said uniform object-oriented structure from said one or more interface engines, for composing said medical image objects for display by said graphical interface, and for transmitting said composed medical image objects to the requesting graphical interface.

Brief Summary Text (25):
In a first aspect, the first embodiment also includes that said one or more computer systems are further configured with one or more report interface engines for retrieving medical report data associated with said medical image data from one or more existing storage systems and for presenting retrieved medical report data as medical report objects with a uniform object-oriented structure, and wherein said one or more image object coordinators further receive medical report requests associated with said medical image data transmitted from one of said graphical interfaces, obtain medical report objects in said uniform object-oriented structure from one or more report interface engines, compose said medical report objects for display by said graphical interface, and transmit said composed medical report objects to the requesting graphical interface.

Brief Summary Text (26):
In a second aspect, the first embodiment also includes: that said one or more computer systems are further configured with a plurality of image object coordinators; that said one or more computer systems are further configured with one or more security object servers for checking the authorization of said user to access the medical image distribution system and to access requested image objects; that said one or more computer systems are further configured with one or more personalization object servers for providing to said image object coordinator information for composing said image objects according to interface preferences of the user and according to capabilities of the client workstation; that said one or more computer systems are further configured with one or more web servers for downloading access-data forms and object-oriented graphical interface modules to client workstations; and that said one or more computer systems are further configured with infrastructure modules of a distributed object system.

Brief Summary Text (27):

In a third aspect, the first embodiment also includes that said medical image data comprises radiology image data or cardiology image data.

Brief Summary Text (29):
In a fifth aspect, the first embodiment also includes that the system further comprising a middleware database for storing persistent data and objects and wherein said middleware database stores definitions of said uniform object-oriented structures of said medical image objects.

Brief Summary Text (31):
In a second embodiment the invention includes a method for medical image distribution from one or more existing image storage systems to a user at a client workstation comprising: obtaining a user request for a medical image; obtaining image data for the requested medical image from one of said existing image storage systems; converting said image data into one or more image objects having a uniform object-oriented structure; composing said one or more image-object according to user preferences and client workstation capabilities; and displaying said composed one or more image objects to the user.

Brief Summary Text (32):
In a first aspect, the second embodiment also includes, prior to the step of obtaining image data, steps of checking identification provided by the user to authorize the user to obtain medical images and of checking the authorization of the user to access the requested medical image object.

Detailed Description Text (2):
The medical image server middleware is built upon a distributed object infrastructure, which is described next. In view of the capabilities of this infrastructure, hardware and software architectures of the middleware are described following. Finally, details of the middleware databases and request processing procedure are described.

Detailed Description Text (4):
The middleware software for medical image distribution according to the present invention is structured according principles of distributed object-oriented programming. Object-oriented programming, generally, as is well-known to those of skill in the art, structures programs into objects, each of which is a self-contained collection of data and of methods which act on the data. Program execution occurs as client objects make requests of and receiving data from server objects.

Detailed Description Text (10):
Medical Image Server Hardware Architecture

Detailed Description Text (11):
Referring now to FIG. 1, there is shown exemplary embodiment 10 of a medical image distribution system according to the present invention. The basic three-tier architecture of this system is apparent from this figure. In the first tier are existing medical image information systems, represented generally as system 14 at Hospital 1, system 16 at Hospital 2, and so forth, which currently store medical images and associated information. Also in the first tier, represented schematically at 42, are additional existing systems which can store non-radiology, e.g., cardiology, related medical images or other medical information other than images made uniformaly and rapidly available through the medical image server of this invention. In the second tier is medical information server 12, which provides for uniform and rapid distribution of information between the first-tier systems and the third-tier client systems, such as workstation 38. Although illustrated as a single system, as well become apparent subsequently, medical image information server 12 can be implemented either on more than one computer system, according to convenience and performance requirements, or can be collocated on one computer

system with other components of the image distribution system of this invention. Also present in the middle-tier are other object-based health-care information systems, in particular Master Patient Index ("MPI") system 40. Third-tier client systems include user equipment ranging from thin clients, to standard PCs, to more powerful UNIX workstations, as well as possibly including specialized devices All such client devices are referred to herein as "client workstations or simple as "workstations".

Detailed Description Text (12):
In more detail, an exemplary existing medical image information system, such as might currently be found in a hospital and interfaced to middle-tier medical image server 12 of the present invention, is represented by equipment 14. Illustrated therein are an existing PAC system 26 which communicates to attached systems over links 28, perhaps conforming to a version of the DICOM standard. The attached systems include workstations, such as workstation 30, dedicated to PAC image display functions.

Detailed Description Text (13):
Also attached is CORBA Image Interface Engine ("CIIE") 32, which interfaces between the PAC system and medical image server 12. Interface engine 32 functions as a server of image objects with IDL defined interfaces, which are the uniform for all attached PAC systems. Upon receipt of a client image object request transferred, for example, according to the CORBA/IIOP protocol, the CIIE implementation translates it into an equivalent PAC system request, perhaps formatted in a DICOM compliant manner. Upon receipt of the PAC image data or response, the CIIE implementation formats it according to the defined IDL interface into a response to the client object, which is transmitted according to the CORBA/IIOP protocol over links 34. In this manner, the specialized details of the PAC system are hidden from a client, which sees only uniform image object interfaces accessible by standard CORBA/IIOP protocols regardless of the details of the PAC system, such as whether it is DICOM compliant or not. The CIIE maps the IIOP protocol onto the DICOM conformant interfaces, or other proprietary interfaces, of the PAC system.

Detailed Description Text (14):
Also present as part of the exemplary medical image system is RI system 18. This system also communicates over links 20 to attached workstations, such as workstation 22, in a manner which is optionally be HL7 compliant. Also attached to RI system 18 is CORBA Report Interface Engine ("CRIE") 24, which performs a similar function for the RI system as CIIE 32 performs for the PAC system. In particular, CRIE interface engine 24 functions as a interface for report objects with IDL defined interfaces, which are uniform for all attached PAC systems, and which are accessible according to the standard CORBA/IIOP protocol. Accordingly, the specialized details of the RI system are hidden from a client object, which sees only uniform report object interfaces regardless of the details of the RI system, such as whether it is HL7 compliant or not. In detail, upon receipt of a client report object request transferred according to the CORBA/IIOP protocol, the appropriate CRIE implementation translates it into an equivalent RI system request, perhaps formatted in a HL7 compliant manner, and upon receipt of the RI report data or response, the CRIE implementation formats it according to the defined IDL interfaces into a response to the client object, which is transmitted according to the CORBA/IIOP protocol over links 34.

Detailed Description Text (15):
CRIE 24 and CIIE 32 are illustrated for purposes of illustration and without limitation as separate systems collocated in Hospital 1 with the interface PAC and RI systems. Alternatively, these interface engines may reside on a single system, which can be optionally collocated with medical image server 12. Also for purposes of illustration, these interface engines are illustrated as each interfacing one PAC or RI system. Alternatively, each interface engine can interface more than one PAC or RI system of the same type, separate interface engines generally being

required to interface to different types PAC or RI systems in order to match each system's unique interface definition to the uniform object interfaces defined in the medical image server of this invention. The instant invention includes the other implementation details that will be apparent to one of skill in the art.

Detailed Description Text (16):
Returning to FIG. 1, the remaining components of the exemplary system therein illustrated are now described in more detail. Master Patient Index ("MPI") system, is a middle-tier system, preferably present in order to obtain relevant patient identifiers for use in the system of the present invention. Each existing first-tier PAC and RI system typically implements patient identifiers which are unique and specific to that system. Medical image server 12 may implement and require another form of patient identifiers. Finally, health-care personal using the medical image server system usually easily identify patients in terms of name along with certain demographic characteristics instead of with details of the patient identifiers maintained by the various systems having patient information of interest. MPI system 40 is an object-based middleware server present in a system of this invention to translate between these forms of patient identification. Although this invention is adaptable to any MPI system providing such function, in a preferred embodiment, MPI system 40 implements interfaces defined by the OMG/CORBAmed Patient Identification Services ("PIDS") and Master Patient Index IDL standard (available from the OMG).

Detailed Description Text (17):
In the third-tier of the medical image distribution system of this invention are client systems, such as system 38, presenting graphical user interfaces ("GUI") which health-care personal use to request and view medical image information from the medical image distribution system. Client systems are linked via network links 36 to medical image server 12. Preferably, links 36 implement the TCP/IP suite of protocols, and accordingly, can be a campus intranet, a wide-area intranet, or even the Internet. In each situation, appropriate security protocols, for example the secured socket layer or other link encryption protocols, are used to insure confidentiality of medical information.

Detailed Description Text (18):
In a preferred embodiment, the client GUI is implemented as an object-oriented interface components of which are downloaded as needed from image server 12. Since only Java currently provides for such download, the client GUI is preferably written either as a Java application or as Java applets in conjunction with a web-browser. The GUI interface present client objects that request information, in particular, medical image data, from medical image server 12. Advantageously, therefore, client and server objects communicate, mediated by the ORBs, over network links 36 using the CORBA/IIOP protocol. In the preferred embodiment, the Java application or applets can be downloaded dynamically when a health-care user accesses the image distribution system and requests particular image data. In that manner, the GUI appropriate for the particular user, the particular workstation, and the particular image data can be made available at any user access equipment. Since the GUI components necessary for particular information or images are downloaded with the images, the most appropriate image display can always be assured throughout the system. A further advantage of the latter arrangement is that display of new types of information can be automatically and routinely provided for by simply downloading new Java-coded GUI objects for their display.

Detailed Description Text (20):
Medical Image Server Middleware Software Architecture

Detailed Description Text (21):
FIG. 2 illustrates the detailed software architecture of an exemplary preferred embodiment of the principal components of the image server middleware 50 for medical image server 12. Each illustrated component is individually described in

the following. First, Object Request Broker ("ORB") 52 plays a key system role in enabling the other objects of the system to make requests and receive responses in a distributed environment. One ORB is present on each computing system hosting the image server middleware. The ORB routes invocations between client and server objects transparently, so that these objects do not need to be aware of any communication details or network structure. Where objects reside on the same machine, requests and responses are routed preferably by direct procedure calls internal to the resident machine between the objects and the ORB. Where objects reside on different computing machines, the ORBS on the two machines communicate the requests and responses between the objects via the CORBA/IIOP. The ORB also assumes responsibility for object management, including, for example, object activation and termination, object replication, object persistence, and so forth.

Detailed Description Text (24):
Before describing image object coordinator 54, which is central to the operation of the image server middleware, supporting personalization object server 58 and security object server 60 are described. The personalization object server is a CORBA object server that stores and retrieves profile data from the middleware database. The profile data can include client system profile data and user profile data. Client system profile data defines the characteristics of a particular client workstation currently accessed by a user, including, inter alia, hardware characteristics such as display resolution and network link speed, and software characteristics such as whether the GUI is resident or to be downloaded. User profile defines user adjustable GUI preferences, such as display layout preferences, font sizes, and default medical image resolutions.

Detailed Description Text (25):
The security object server provides security and access control information necessary to protect medical image data from unauthorized access. Security information specifies, inter alia, key management and encryption algorithms to be used in user sessions with particular client workstations over particular network links. Access control information includes, inter alia, user access control and object access control information. User access control identifies and legitimizes a particular user of the system, and can be by traditional user-id and password or by newer biometric techniques, such as fingerprint identification. As part of legitimization, this information can also specify user role and group, for example, attending or resident physician, nurse and so forth, and object access privileges, for example, all patients, all assigned patients, limited data for assigned patients, and so forth. Object access control information can specify, for each object or group of objects, which users or user groups are allowed access and what levels. Optionally, the security object server can also provide services to date and log an audit trail of each user session.

Detailed Description Text (26):
Again referring to FIG. 2, image object coordinator 54 plays a central role in the image server middleware. Generally, this object server receives client object requests generated by the GUI from user input transparently via ORB 52 from the object-oriented GUI running on a client workstation, such as workstation 38, accessed by the user for medical image data or report data. This object server then, first, checks that the user is authorized to access the requested data by comparing user and object access information from the security object server. If access verification fails, an indication of this failure is returned to the client. Second, if the access verification succeeds, this server interprets these requests and forwards them, again transparently via ORB 52, to the appropriate object interfaces presented by the appropriate CIIE and/or CRIE. Next, responses from the first-tier systems are retrieved from the CIIE and/or the CRIE object interfaces, and the image object coordinator composes the responses for transmission to the client workstation according to the user profile preferences and the client workstation capabilities obtained from the personalization object server. Finally, the image object coordinator returns the composed responses to the object-oriented

GUI completing a response to the user request.

Detailed Description Text (28):
The interface engines together with the image object coordinator present medical image object and report object interfaces to client objects that are uniformly defined regardless of the types of the interfaced PAC and RI system. These object interfaces are designed to provide the basic image, patient, and interpretation information known in the art. One or more versions of these uniform object interfaces may be available depending on image or report type. The structure of these interfaces is preferably made available as object definitions in middleware database 62. Accordingly, the GUI interfaces at client workstations can query this database and determine the structure of available image objects.

Detailed Description Text (29):
Concerning image information, the object interfaces provide basic medical image characteristics and image data for radiography images, computed tomography image, magnetic resonance images, nuclear medicine images, ultrasound images, and so forth. Image information is identified as single frame images, groups of single frame images, multi-frame images, and so forth. Concerning patient information, the object interfaces provide for patient identification and demographic information, patient visit information, patient study information, study component information, for the relation of image and patient information, and so forth. Concerning interpretation information, the object interfaces provide for results and interpretation information and for the relation of interpretation information to the other classes of information. Although, the object interfaces are described without limitation in terms of known imaging modalities and techniques, these interfaces can be extended to accommodate provide for new imaging modalities and techniques.

Detailed Description Text (33):
Finally, web server 56 provides infrastructure, non-object-oriented functions necessary for initiating and maintaining user sessions. At session initiation, web server 56 downloads access information. Where the client workstation accesses the system through a web browser, this information preferably includes HTML (hypertext transfer markup language) or XML (extensible markup language) pages defining system logon. After a session is started, this sever downloads GUI components as needed for the medical image and report information to be displayed. These typically include Java applets for a web browser or a complete Java GUI application. Alternatively, where part of the GUI are cached or resident on a client workstation, web browser 56 may need only to provide for session initiation.

Detailed Description Text (41):
Personalization data segment 88 includes user profiles/preferences component 90, which stores user GUI preferences, and optional client workstation component 92, which stores workstation characteristics. Accordingly, the personalization object server, using both components, provides that any user can access the medical image distribution system of this invention at any workstation and receive image and data presentation according to the user's preferences and within the capabilities of the workstation that the user happens to access. This segment is also preferably structured as an object-oriented database.

Detailed Description Text (46):
A general preferred exemplary procedure for processing user requests for medical image or report data is described in this section with reference to steps illustrated in FIG. 4.

Detailed Description Text (47):
Beginning at step 120, a user physically access a client workstation, and at step 122 requests download of an access-data form by the web server. For example, an HTML home-page of the medical image server is downloaded by the web server into a

web browser when the user enters the web address (universal resource locator) of the image server. This page requests entry of user identification information. At step 124, the user enters text or biometric identification data and the filled-in access-data form is returned from the web browser for user validation. The web server in cooperation with the security object server performs the user validation. At step 126, if the user is validated, the web server then downloads the initial Java applets or initial Java application modules to build the GUI for medical image or report requests. Also downloaded is an object reference of the image object coordinator. If the user is not validated, an error indication is returned to the client workstation.

Detailed Description Text (55):
Finally, at step 146 the user can either request more medical image and report data or can indicate a desire to logoff from the system. In the latter case, at step 148 the web server terminates the connection with the client workstation.

Detailed Description Text (57):
Although the above description has been in terms of radiology images and report data stored on existing PAC and RI systems, the medical image server according to this invention is not limited to just radiology data. One of skill in the art will readily understand how to incorporate other medical image sources and other medical data in general. It will be appreciated that the medical image system of this invention is functionally extendible by a routine procedure. It has previously been described how this system of scalable to achieve adequate performance with appropriate cost.

Detailed Description Text (61):
One of skill will also appreciate how the medical image server of this invention can be further extended to make available additional medical non-image information. The medical image distribution system would be extended, at least, with additional interface engines, for making available in a uniform object-oriented fashion the additional medical data stored in existing system, and with additional object coordinators, for retrieving and transmitting the additional uniform medical objects to client workstations. The additional medical information can include, for example, information from laboratory computing systems or from pharmacy computing systems or from administrative computing systems.

Current US Cross Reference Classification (3):
707/103R

CLAIMS:

1. A medical image distribution system for distributing medical images from one or more storage systems for medical images to a plurality of network-attached client workstations, said medical image distribution system comprising one or more network-attached computer systems, and

wherein each said network-attached client workstation is configured with a graphical interface for receiving medical image requests from a user, for transmitting the received medical image requests in an object-oriented format, and for displaying medical image objects received in response to the transmitted requests to the user; and

wherein said one or more network-attached computer systems are configured with

infrastructure modules of a distributed object system for forwarding and transmitting of object requests and responses,

one or more interface engines, each said interface engine presenting a uniform object-oriented interface for retrieving medical image data from the existing

storage systems by translating requests between the uniform object-oriented format and individual formats recognized by the storage systems and for returning retrieved medical image data as medical image objects in the uniform object-oriented structure, and

one or more image object coordinators for receiving the object-oriented medical image user requests transmitted from said client workstations, for obtaining objects with requested medical images by forwarding retrieval requests in the uniform object-oriented format to said one or more interface engines, for composing said obtained medical image objects according to preferences of the user and capabilities of the client workstation for display at the client workstations, and for transmitting said composed medical image objects to the requesting client workstation as a response to the transmitted object-oriented user requests.

2. The system as claimed in claim 1, wherein said one or more computer systems are further configured with

one or more report interface engines, each said report interface engine presenting a uniform object-oriented interface for retrieving medical report data associated with said medical image data from the existing storage systems by translating requests between the uniform object-oriented format and individual formats recognized by the storage systems and for returning retrieved medical report data as medical report objects in the uniform object-oriented structure, and

wherein said one or more image object coordinators further receive object-oriented medical report user requests associated with said medical image data transmitted from the client workstations, obtain objects with requested medical reports by forwarding retrieval requests in the uniform object-oriented format to said one or more report interface engines, compose said obtained medical report objects according to preferences of the user and capabilities of the client workstation for display at the client workstations, and transmit said composed medical report objects to the requesting client workstation as a response to transmitted object-oriented user requests.

4. The system as claimed in claim 1, wherein said one or more computer systems are further configured with one or more security object servers and, wherein the security object servers, in response to object-oriented requests from the image object coordinators, check authorization of said user to access the medical image distribution system and to access requested image objects.

7. The system as claimed in claim 1, wherein said medical image data comprises radiology image data.

8. The system as claimed in claim 1, wherein said medical image data comprises cardiology image data.

13. The system as claimed in claim 12 wherein said middleware database data further comprises definitions of said uniform object-oriented formats of said medical image objects.

20. A method for medical image distribution by one or more network-attached computer systems from one or more storage systems for medical images to a user at a network-attached client workstation comprising:

receiving a user request at a client workstation for a medical image,

transmitting the received user request for the medical image in an object-oriented format from the client workstation to an image object coordinator at the one or more network-attached computer systems,

forwarding a retrieval request for the requested medical image in a uniform object-oriented format from the image object coordinator to an interface engine at the one or more network-attached computer systems,

retrieving the requested medical image data for the requested medical image by the interface engine from one of said existing storage systems, wherein the retrieving further comprises translating requests between the uniform object-oriented format and individual formats recognized by the storage systems,

composing medical image objects received by the image object coordinator from the interface engine in the uniform object-oriented format according to preferences of the user and capabilities of the client workstation,

transmitting said composed medical image object by the image object coordinator to the client workstation as a response to the transmitted object-oriented user request, and

displaying by the client workstation of said transmitted composed medical image objects to the user.

21. The method of claim 20 further comprising, prior to the step of forwarding a retrieval request, a step of requesting a security object server to check identification provided by the user to authorize the user to obtain medical images and of checking the authorization of the user to access the requested medical image object.

L9: Entry 10 of 20 File: USPT Jan 13, 2004

DOCUMENT-IDENTIFIER: US 6678703 B2
TITLE: Medical image management system and method

Abstract Text (1):
The present invention provides a medical image management system and method that uses a central data management system to centrally manage the storage and transmission of electronic records containing medical images between remotely located facilities. A polling system is provided with remotely located workstations or local workstations so that the remote or local workstations may request queued data to be delivered that is awaiting delivery in the central database management system. The remotely located workstation or local image workstation communicates with a remotely located central data management system via a remote interface over the internet. The central database management system maintains and update any changes in the IP address of a remote or local workstation, in a look up table. The central data management system may also, in addition, push data when received to the last known IP address in the look up table.

Brief Summary Text (2):
The present invention is a system and method for managing medical images. More specifically, it is a computer-based system and method for capturing, transmitting, storing, processing, and communicating electronic records associated with medical images.

Brief Summary Text (4):
Diagnostic imaging technology has evolved tremendously in the past twenty years, offering very sophisticated imaging tests such as magnetic resonance imaging (MRI) and computed tomography (CT). The MRI market in particular includes approximately 6,000 MRI machines in the United States, and 12,000 worldwide. Two-thirds of MRI devices in the US are located clinics and small hospitals. There are over 12,000 CT scanners in the United States and over 20,000 worldwide. Other significant medical imaging markets include for example, ultrasound, nuclear medicine, digital x-ray, and computerized radiology. On the aggregate, the potential medical image management market has been estimated at $5.5 Billion annually in the US and $12 Billion worldwide.

Brief Summary Text (5):
The need for immediate electronic delivery and convenient, economic storage of radiologic and other medical images and data has never been greater. The annual United States radiology market consists of more than 150 million x-rays, 100 million sonograms, 20 million MRI scans and 30 million CT scans performed by medical practitioners. The conventional process for managing medical images at most hospitals, clinics and imaging centers is as follows. The medical image is printed onto sheets of film, which are delivered to the radiologist for interpretation. After the transcribed report is delivered to the radiologist, reviewed for errors and signed, the films and report are delivered or mailed to the referring doctor. This process often takes several days, up to a week. If questions arise, the referring doctor contacts the radiologist, who may be forced to rely upon memory, having reviewed the films several days before and no longer has possession of them. Also, the referring doctor must then manage the hard-copy films, either by filing the films in his office, or returning the films to the imaging center or hospital

to be filed, depending upon practices in the local community. If the patient then goes to a second doctor, requires surgery, or requires another medical imaging procedure, the films must be located and physically carried or shipped to the hospital, surgery center, or to the second doctor's office. There are numerous opportunities for films to be lost or misfiled, and doctors who maintain more than, one office may not always have the correct patient films in the correct office.

Brief Summary Text (6):
The current film-based system is very expensive, and the charges for films, processing chemicals, and delivery can easily add up to $30 to $50 per MRI patient study. A typical MRI center scanning 300 patients per month has equivalent costs of approximately $12,000 per month ($40 per study.times.300 patients/month). Other problems for the imaging facility are the numerous opportunities for the films to be physically lost, as well as the considerable time, personnel, and expense required for the delivery and retrieval of these films. Estimates are that up to 25% of medical images are not accessible when required.

Brief Summary Text (7):
Currently, no widely established commercial Internet solution exists for the digital delivery and archiving of the ever-increasing vast stores of radiologic data. Many patients are accustomed to sending email with various attachments, such as files or photos, and wonder why radiology images cannot be "emailed" to their doctors. However, several barriers exist for a medical image to be "emailed" to the doctor.

Brief Summary Text (8):
In order to electronically transport medical images efficiently, the images must be in a digital format. The imaging device, such as the MRI machine, must have the computer interfacing hardware and software configured to "export" the data. A computer is needed to convert the proprietary image identification data (the header information) into a standardized format, such as DICOM (Digital Imagine, and Communication in Medicine). Also, the doctor who receives the images must have software that allows him or her to view the medical images and interpret the image header information (viewer). However, non-DICOM enabled models represent the majority of imaging machines. Due to financial constraints imposed by managed care on imaging centers, non-DICOM machines will continue to dominate diagnostic imaging for the foreseeable future.

Brief Summary Text (9):
When digital modalities such as CT and MRI first came into general clinical use, each manufacturer used its own proprietary means of reconstructing the data, formatting files and storing each of the studies. They did not share this basic information with other competing manufacturers; therefore, one set of images could not be communicated to another machine since each had a different format. In 1983, the American College of Radiology and the National Electronic Manufacturers Association met to discuss a standard. In early 1984 the two organizations formed the Digital Imaging and Communication in Medicine (DICOM) Standards Committee. After many years of extensive work, the first DICOM model was introduced in 1992. By late 1994, a few manufacturers had begun to offer to incorporate DICOM into their products, usually as an expensive ($20,000-$40,000) upgrade. However, even today, the majority of these manufacturers still today only incorporate DICOM in their new products for a significant extra charge ($20,000-$40,000). Many of the older established medical imaging systems do not even have a DICOM conversion available from the original equipment manufacturer. Whenever a DICOM conversion upgrade is available for already built and installed products, it is usually even more expensive than DICOM for a new product. DICOM is a communications standard and does not define particular hardware architecture. It permits integration of images into non-image databases and is the predominant standard for medical image communication. It enjoys broad support across specialties and other standards organizations throughout the world.

Brief Summary Text (10):
Interfaces have been developed to "DICOM enable" imaging systems that were not originally factory equipped with DICOM. Without supplying DICOM interfaces as a component of an overall system, a medical image management system in the general field contemplated by the invention would be required to take one of three courses of action: 1) limit their imaging center users to DICOM conformant equipment, 2) purchase or require their customer to purchase and install DICOM interfaces at a cost of upwards of $40,000, or 3) rely on a technique known as secondary capture. In the case of secondary capture methods, like video frame grabbing, some of the information is lost, because it only captures the 8-bit analog representation of the original 16-bit image pixel data. Also, secondary captured images cannot be later manipulated to the same degree as the original images. Because of the inherent drawbacks of secondary captured data, the American College of Radiology (ACR) standard states that the direct capture method is preferred for primary diagnosis.

Brief Summary Text (11):
It is not believed that the general imaging center and referring physician marketplace will tolerate the use of the inferior secondary capture method, or an ASP that can only connect to DICOM equipped imaging systems. The system and method of the present invention provides DICOM connectivity. Also, in order to transmit and store images without compromising the quality or integrity of the imaging data, an efficient medical image management system is preferably able to successfully connect disparate imaging equipment and systems without compromising the image quality. To accomplish this the system should be able to extract the proprietary data from various different imaging machines, again the vast majority of which are not DICOM enabled and therefore cannot "output" the data in the DICOM format. Moreover, though DICOM is the universal industry standard, like the English language different "dialects" of DICOM exist depending on how each of the many individual manufacturers "speak" the DICOM language. What this means is that it is quite common for two systems that have DICOM interfaces to still have difficulty connecting and communicating with each other. Therefore, customization of interfacing, between such machines may be required in some circumstances.

Brief Summary Text (12):
Once these above barriers are overcome, it becomes possible to electronically transmit medical images in an efficient and readily adoptable manner. These electronic images, unlike film, can be simultaneously presented in multiple locations immediately after an imaging study is performed.

Brief Summary Text (14):
Various solutions have been developed with the intention of streamlining the storage and accessibility of medical images by managing, electronic records that include the images in electronic form that may be converted for viewing, such as on screen displays or via film printers.

Brief Summary Text (15):
One well-known type of such a system called "Picture Archiving and Communications Systems" (PACS) generally provides medical image management via a collection of components that enable image data acquisition, transmission, display, and, storage. Such systems are implemented in imaging clinics and hospitals to make the digital data available at different locations within the radiology department or the facility. Further, the use of such systems is generally restricted to in-house radiology and other departments, thus excluding the referring physicians, who are outside the imaging facility. These systems have high price tags ($60,000 to $ 1,000,000) for the local installation of the respective central image management and storage systems generally required, and involve other high costs related to additional personnel to configure and maintain such image management systems locally onsite at the imaging facility.

Brief Summary Text (16):
Medical Images and Internet ASP's

Brief Summary Text (17):
Because the medical image management market is so large, and represents such large volumes of recurring transmissions of electronic records associated with medical images, an ASP model for managing electronic images provides great potential for a highly profitable annuity business. Various efforts have recently been made to replace or at least significantly enhance the conventional film-based systems and methods for medical image management by managing these images electronically, and more particularly via an internet-based ASP model. However, the concept of an Internet based Application Service Provider (ASP) for the transmission and storage of medical images is an industry in its an embryonic stage. Very few, if any, of the over 300 diagnostic imaging procedures performed annually in the U.S. are being transmitted and/or stored utilizing an ASP model.

Brief Summary Text (18):
To transmit an image electronically as is intended with these known medical image management systems, the first step is to get the data from the imaging modality (CT, MR, ultrasound, etc.) to the image acquisition system at the customer site. There are two methods of obtaining this data: primary and secondary data capture. Because primary capture is not always possible in order to support other known medical image management systems and methods, they often use "secondary" or "indirect" methods. The simplest and oldest "secondary" capture method is often called "frame grabbing". This method simply obtains the image present on the video monitor and records it. The resulting image is only 8 bits deep allowing 256 shades of gray, which means a significant amount of image data has been lost. The use of "frame grabbing" is also very labor intensive. When using "frame grabbing", the technologists must pre-set the "window" and "level" (brightness and contrast) of the image. This requires an excessive amount of the technologist's time when compared to the more modem primary capture. These frame grabber systems work by taking the analog monitor output from a digital modality and running it through an analog-to-digital converter, which in itself degrades the data. The ability to adjust the brightness and contrast (window and level) of the image on the receiving end is also limited with images that were obtained using "secondary" capture. Measurements and position location of the image, both extremely important to the physician, are not generally possible with acceptable accuracy using secondary capture. Furthermore, due to problems described above, the latest version of the American College of Radiology (ACR) standards for teleradiology effective Jan. 1, 1999, recommends compliance to DICOM and transfer of the full image data set, which is only possible with "primary" or "direct capture" for primary diagnosis.

Brief Summary Text (19):
In general, most of the known systems and methods for managing medical images in electronic record format use "pull" type image delivery protocol which requires the referring physician to log on to a web server and then download his or her patient's images. However, busy physicians do not have the time or the desire to access their patient's images in this manner. The "pull" model requires the physician to log in as well as extensive physician input and time to initiate the data transfer. Additionally, the doctor must then wait for the image data to download.

Brief Summary Text (20):
Various more specific examples of such medical image ASP efforts are summarized in relation to respectively known companies in the general field as follows (much of the information provided immediately below is based upon information and belief, and in some cases is based only on rumor and verbal discussion--therefore the general and detailed elements for these companies may not be wholly accurate).

Brief Summary Text (21):
The following is a description of what is believed to be information related to a medical image management system to be provided by a company called "Amicas". Amicas is a private company located in Newton, Mass. that is believed to market and sell software that allows radiology studies to be sent between Web servers. The target market for Amicas is believed to be large hospitals. It is believed that Amicas plans to enable the transfer of such images between any medical facilities that have standard e-mail systems, using UPS Document Exchange (SM)--an encryption-based secure delivery service featuring optional password protection, real-time racking and delivery confirmation. The physician still must login to get his or her email, and wait for the images to download. The company is currently using the service at 4 beta sites. The Company gained FDA approval in 1997. To qualify as a potential customer a client's machines must have DICOM installed. CEO Dr. Adrian Gropper stated in an interview conducted May 2, 2000 at the E-Healthcare Conference in Las Vegas Nev. that Amicas has no plans to develop custom DICOM interfaces. Dr. Gropper has also stated that his company has no plans to offer any form of off site storage. It is further believed that the company uses lossy compression of the electronic records associated with medical images they manage. It is believed that Amicas has a test site which is located at the Loma Linda Veterans Administration Hospital.

Brief Summary Text (22):
The following is a description of what is believed to be information related to a medical image management system to be provided by a company called "eMed". eMed is a private company located in Lexington, Mass. The target users are hospitals. The eMed.net service is believed to include a medical image viewing application with integrated access to medical images and reports along with other relevant information through a physician's web site. eMed Technologies is a Healthcare Application Service Provider (HASP) and takes care of everything from server hardware, domain name registration, site creation and current content, all for a monthly subscription fee of $2,500. The company has FDA approval. The company prefers DICOM equipped machines, but is able to capture images from non-DICOM imaging machines in two ways: (1) DICOM converting device at a customer cost of up to $40,000; and (2) frame grabbing--a form of secondary capture which is believed to be unacceptable for primary diagnostic interpretation.

Brief Summary Text (23):
The following is a description of what is believed to be information related to a medical image management system to be provided by General Electric Medical Systems, Dallas, Tex. and Waukesha, Wis. stated in a press release dated Apr. 9, 2000 that GE will use an ASP model to primarily store data generated at an off-site location. It is believed that this recent announcement addresses an ASP model for GE's traditional PACS system. The press release claims that GE will pilot the program during the summer of 2000. The press release does not mention numerous details (such as connectivity to their system i.e. whether non-DICOM compliant machines will ever be offered the service; whether only GE or non-GE equipment will be targeted; whether GE plans to develop any DICOM interfaces to non-DICOM equipment; what data specifically is planned to be stored). The press release mentions a network subscription fee arrangement but does not give any pricing details. Most importantly, GE does not deliver the images, but instead has the doctors log on.

Brief Summary Text (24):
The following is a description of what is believed to be information related to a medical image management system to be provided by Image Medical, a private company located in Palo Alto, Calif. The target market is large institutions. Image Medical uses an ASP model to transmit medical images over the Internet. The Image Medical system is called "Practice Builder". It is DICOM compliant and works with existing PACS and provides the ability to access images and reports anywhere. "Practice Builder" includes a "Viewer" for digital medical images, CT, MR, US, DR, CR and NM. The revenue model is an activation fee that covers connectivity, infrastructure and

installation costs. A per transaction fee is then charged for image acquisitions, distributions and archival. The company is not developing interfaces for imaging machines that are not DICOM equipped.

Brief Summary Text (25):
The following is a description of what is believed to be information related to a medical image management system to be provided by a company called "Inphact", a private company located in Nashville Tenn. Inphact claims to integrate an Internet based ASP PACS with a RIS. The target market is any hospital or clinic that is unable to afford an in-house PACS. RadWeb.TM. allows physicians to query radiology images 24/7 via the Internet. The company plans to extend its technology platform in the future to cardiology. The company is not believed to offer push technology, image history record system, or custom DICOM interfaces.

Brief Summary Text (26):
The following is a description of what is believed to be information related to a medical image management system to be provided by In Site One, Inc. which is located in Wallingford, Conn. The primary target market is hospitals. In Site One is a service provider offering digital image storage and archiving for the medical community. For this company, the imaging device must be DICOM compliant. "In Dex" (Internet DICOM Express) is a transaction, pay as you go service for storage and archiving of DICOM images for hospitals. In Dex's open architecture integrates with any PACS component as well as hospital networks and information systems. Images can be accessed via the Internet or through virtual private networks to a hospital's network. In Dex is suited for facilities with or without PACS capabilities. For PACS owners, In Dex enables them to outsource the storage and archiving component. For non-PACS equipped facilities, In Dex delivers storage and archival of a PACS without the high capital outlay, maintenance costs, technical upgrades and staffing support. There is no delivery of images to referring physicians nor do referring physicians have access to view the images they order.

Brief Summary Text (27):
The following is a description of what is believed to be information related to a medical image management system to be provided by Radiology.com, which is located in Los Angeles, Calif. and Chantilly, Va. The target market is hospitals. Radiology.com announced the launch of a service that allows digitized medical images to be stored and retrieved on-line through a central, web-based repository on Mar. 9, 2000. The technology combines DICOM and JAVA that allows a high level of compression and encryption of medical images for transmission to a PC. The system employs an ASP model. The company claims open standards will allow lifetime access to a global central repository of medical images, named "Image Bank". Patients can build their own imaging history through "Patient's Bank" which can be used to obtain discrete second opinions. The revenue model is a pay-as-needed approach. It is believed that this system only exists on paper and no clinical sites have been developed.

Brief Summary Text (28):
The following is a description of what is believed to be information related to a medical image management system to be provided by "Real Time Image", a private company located in San Mateo, Calif. The target market is large hospitals with PACS. PACS on Demand is a product that allows physicians to view images anywhere, anytime, even over dial-up connections. iPACS is a Web server that integrates to PACS, allowing physicians to view images directly from a DICOM archive over the Internet using Microsoft's Internet Explorer.TM. or Netscape Navigator.TM. Web-browsers. The user must install plug-in to his or her browser before attempting any use of this product. iPACS "streams" images on the fly using original image data without pre-processing or requiring separate archives.

Brief Summary Text (29):
The following is a description of what is believed to be information related to a

medical image management system to be provided by "Stentor", a company located in the Silicon Valley. The target market is hospitals with existing Intranets. The Stentor system is PC based. Stentor's "iSYNTAX" technology delivers images only over existing hospital networks. Stentor has FDA approval. Stentor claims its iSYNTAX system will integrate into any existing hospital network. Stentor can send real time images on as slow as a 1 megabyte per second network connection. Images are encoded using a wavelet technology. A lossless representation of the transmitted image is claimed; however, lossless transmission (as the present invention performs) is not claimed. Stentor claims no bills will be sent until real savings by the imaging department have been demonstrated. Stentor charges on a per use basis.

Brief Summary Text (31):
In one regard, other systems intending to provide a medical image ASP service generally require timely log-on and download procedures at the physician terminal. In another regard, none of the other systems and methods intended to provide a medical image ASP are believed to provide the image center with a history record of where and when images are sent, received, and viewed. However, a system which pushes the images directly to remotely located desktops of interested healthcare providers or patients outside of the imaging clinic would be much more resource efficient at their end. Furthermore, medical imaging centers producing the electronic images would benefit from a system which provides them with a real-time, image history record with easily accessible information about the times and places that each image is sent, received, and viewed at all locations.

Brief Summary Text (32):
Also, other efforts intended to provide a cost-effective ASP generally require costly hardware investment, principally on the part of the respective imaging center, and according to some of these efforts per-use fees are charged for each image viewing occasion. However, smaller imaging clinics and healthcare providers outside of the imaging center would benefit from a business model which provides the associated image work-stations necessary to use the ASP without requiring capital expenditure on the hardware or software. These parties would be greatly benefited by a method that provides a medical image ASP on a monthly service fee only basis, without up-front hardware costs, and without costly "per-use" transaction fees. Moreover, by providing a medical image ASP that charges only the imaging clinics on a fixed fee basis, these centers would be able to solely enjoy the economic benefits of their increased revenues flowing from increased image volume, at least to the extent that such volume is charged through to payers. In particular, the imaging center would benefit from an electronic medical image ASP system that charges only fixed or per use fees, but that provides without direct capital expenditure a local image workstation at the imaging center (including in one aspect a DICOM conversion interface) for interfacing with the remotely located, central management system of the ASP. Other interested healthcare providers and patients outside of the imaging clinic would also greatly benefit from having access to a remote image viewing system for viewing and storing the electronic images available from the ASP, but without requiring them or the imaging center to pay for the viewing system.

Brief Summary Text (34):
The present invention provides a medical image management system and method that reduces the high financial cost, resource allocation, time, and unreliability associated with conventional production, transportation, and viewing of conventional film-based systems and methods.

Brief Summary Text (35):
The invention in another regard also provides a medical image management system and method that reduces the need for purchasing and/or managing sophisticated technology at medical imaging centers.

Brief Summary Text (36):
The invention also provides a medical image management system that directly addresses the needs of the referring physicians and other healthcare providers located outside of the imaging center and having interest in medical image studies.

Brief Summary Text (37):
The invention also provides a medical image management system and method that integrates diagnostic and other analytical software, algorithms, or other tools associated with medical images within one, central medical image management ASP.

Brief Summary Text (38):
The present invention also provides a medical image management system and method that pushes electronic records containing medical images to healthcare providers outside of the medical imaging center soon after the medical images are taken so that the healthcare providers may view the images without the need to remotely access a central image storage cite and find and download a specific, desired image for viewing.

Brief Summary Text (39):
The invention also provides a medical image management system and method that keeps a medical image history record of times and locations where electronic records containing medical images are pushed to and viewed by parties such as healthcare providers and patients outside of the medical imaging center, and that communicates the medical image history record to the medical imaging center which produces the image.

Brief Summary Text (40):
The invention also provides a medical image management system and method that transmits lossless or substantially lossless medical image records to healthcare providers outside of the medical imaging center without requiring the healthcare provider to spend a significant amount of time to access and view the associated medical images.

Brief Summary Text (41):
Accordingly, one mode of the invention provides a medical image management system that includes a medical imaging system, a local image workstation, and a central data management system. The medical imaging system produces an electronic record in a computer-readable format and that comprises an electronic image associated with a region of a patient's body. The local image workstation communicates with the medical imaging system along a local interface such that the electronic record may be transmitted from the medical imaging device and received by, the local image workstation. The central data management system communicates with the local image workstation along a remote interface such that the electronic record may be transmitted from the local image workstation and received by the central data management system. The central data management system is also configured to push the electronic record to a pre-determined remote viewing system in a format such that the electronic record may be read and the electronic image converted to a recognizable, visible format.

Brief Summary Text (43):
According to a further aspect, in the event the medical imaging device does not produce the electronic record in a DICOM format, the local image workstation is adapted to convert the non-DICOM electronic record into receives into a DICOM format for transmission to the central data management system.

Brief Summary Text (50):
Still another aspect of this mode includes a printer that is adapted to interface with at least one of the medical image system, local image workstation, or central data management system and which is adapted to print a recognizable, visible film

associated with the electronic image.

Brief Summary Text (51):
Another mode of the invention provides a medical image management system with a medical imaging means, an image storage means, and an imaging pushing means. The medical imaging means is located at a first location and is for producing an electronic record in a computer-readable format and that includes an electronic image associated with a region of a patient's body. The pushing means pushes the electronic record along a remote interface to a remote image viewing system at a second location that is remote from the first location. Further to this mode, the electronic record is pushed in a format that may be opened such that the electronic image may be converted into a recognizable, visible format.

Brief Summary Text (52):
One aspect of this mode also provides a viewing means associated with the remote image viewing means for viewing the electronic image at the second location. Another aspect also provides means for providing information related to the patient in the electronic record. Yet another aspect provides a DICOM conversion means for converting the electronic record from a non-DICOM format to a DICOM format. Still a further aspect of this mode provides an image history record means for maintaining an image history record related to at least one of the transmission of the electronic record, the receipt of the electronic record, and the viewing of the electronic image. In one regard, this image history record means maintains an image history record related to each of the transmission of the electronic record, the receipt of the electronic record, and the viewing of the electronic image. In one highly beneficial variation, the image history record means includes: means for centrally managing the image history record at a central data management system located at a third location which is remote from the first and second locations; means for communicating the image history record from the central data management system to a local image workstation at the first location; and means associated with the local image workstation at the first location for displaying the image history record.

Brief Summary Text (53):
Another aspect of this mode provides DICOM conversion means for converting the electronic record from the medical imaging means into a DICOM format.

Brief Summary Text (58):
Another mode of the invention provides a medical image management system with a local image workstation, a central data management system, and a remote image viewing system, all respectively configured and networked such that the local image workstation pushes the electronic record via the central data management system to the remote image storage system. More specifically, the local image workstation communicates with a medical imaging system along a local interface at a first location. The local image workstation receives an electronic record that includes at least in part an electronic image from the medical imaging system associated with a body of a patient. The central data management system communicates with the local image workstation along a first remote interface from a second location that is remote from the first location, such that the central data management system receives the electronic record from the local image workstation. The remote image viewing system communicates with the central data management system along a second remote interface from a third location that is remote from the first and second locations. The remote image viewing system has a remote image storage system adapted to store the electronic record in a computer readable format, and is adapted to open the electronic record from the remote image storage system and to convert the electronic image into recognizable, visible form.

Brief Summary Text (63):
Another mode of the invention is a medical image management system with a medical imaging system, a local image workstation, and means for pushing the electronic

image to a remote image viewing, system in a format such that the electronic record may be converted in order to represent the electronic image in a recognizable, visible format.

Brief Summary Text (68):
Another mode of the invention provides a medical image management system with a particular central data management system. The central data management system includes a computer which communicates with an electronic transmission means along a first remote interface and electronically receives an electronic record from the electronic transmission means that includes an electronic image associated with a region of a patient's body. The computer also communicates with a remote image viewing system along a second remote interface and pushes the electronic record in a DICOM format to the remote image viewing system.

Brief Summary Text (72):
Another mode of the invention is medical image management system with a local image workstation which communicates with a medical imaging system along a local interface in order to electronically receive an electronic record from the medical imaging system that includes an electronic image associated with a region of a patient's body. The local image work-station also communicates with a central data management system along a remote interface in order to push the electronic record to the central data management system. The local image workstation is also adapted to receive and display a message from the central data management system related to an image history record with history information that related to at least one of: locations where the electronic record has been sent from the central data management system, locations where the electronic record has been received from the central data management system, times when the electronic record has been transmitted from one location to another location, times when the electronic record has been received at one location from another location, times when the electronic record is opened at a location, and times when the electronic image is viewed at a location.

Brief Summary Text (73):
Another mode of the invention is a method for managing medical images. The method includes in one regard receiving along a first remote interface an electronic record, which includes an electronic image that is associated with a body of a patient, from a medical imaging system located at a first location and at a central data management system located at a second location that is remote from the first location. The method further includes pushing the electronic record from the central data management system along a second remote interface to a remote image viewing system located at a third location that is remote from the first and second locations.

Brief Summary Text (80):
The systems and methods of the invention for managing medical images electronically over remote interfaces such as via the internet also allow for a highly economical method for providing a medical image management ASP in a manner that expands the bottom line for medical imaging centers in particular. Therefore, the invention also includes various modes associated with the economical cost-flow related to the implementation and use of the medical image management sytems of the invention.

Brief Summary Text (81):
Another specific mode of the invention therefore is a method for providing medical image management system. The method provides a local image workstation that communicates with a medical imaging system managed by a medical imaging center along a local interface at a first location. The local image workstation is configured to receive multiple electronic records from the medical imaging system each comprising at least one electronic image that represents at least a portion of a patient's body. The method also provides a central data management system that communicates with the local image workstation along a remote interface from a

second location that is remote from the first location. The method also provides a remote image viewing system that communicates with the central data management system along a second remote interface from a third location that is remote from the first and second locations. Once the local image workstation, central data management system, and remote image viewing systems are installed and interfaced, the method further includes pushing the electronic records from the local image workstation to the remote image viewing system via the central data management system and along the first and second remote interfaces.

Brief Summary Text (85):
According to another aspect, the local image workstation comprises a computer, and the local image workstation including the computer is provided to the medical imaging clinic for use in the medical image management system without directly charging the medical imaging clinic for the local image workstation.

Brief Summary Text (89):
In variation of this embodiment, the polling system is provided with the image push system that uses push technology as described above. According to this embodiment, the polling system will notify the central data management system of the image system, workstation or remote viewer's IP address. The central data management system will store the last known IP address in its database, for example, in a look up table. When the central data management system receives an image or other data, it will attempt to push the image or other data to the last known IP address of the specified remote location. The central data management system pushes data to locations over the Internet using push technology known to one of ordinary skill in the art, in the unique medical image delivery application and system described above with respect to FIGS. 1-6. If the delivery fails after a predetermined number of attempts, the data will be placed in a queue in the central data management system with a destination identifier that identifies the intended recipient. The central data management system delivers the queued data to the remote location when the remote module's polling system notifies the central data management system of the its current IP address or when the polling system requests delivery of queued data.

Brief Summary Text (91):
Another aspect of the invention provides an internal polling system within the local image station for communicating IP address information to the central data management system. Accordingly, in a similar manner, the local system will update its IP address information and request queued data stored in the central data management system. The central data management system will then send queued data such as information concerning delivery and review status of the delivered medical image, to the local system.

Drawing Description Text (2):
FIG. 1 shows a schematic overview of the medical image management system of the invention.

Drawing Description Text (5):
FIG. 4 shows a schematic representation of the medical image management system of the invention as it interacts via the internet with multiple medical imaging centers and multiple remote parties needed access to images.

Drawing Description Text (6):
FIGS. 5A-D show various sequential modes of using the system of the invention for managing access, transport, storage, and history records associated with electronic records of medical images according to the invention.

Drawing Description Text (7):
FIG. 6 shows a schematic overview of a beneficial cost-flow associated with using a medical image management ASP system according to the invention

Drawing Description Text (8):
FIG. 7 shows a schematic representation of a method and system for storing, transmitting, receiving and tracking medical images and associated information of an alternative embodiment of the present invention using the polling system of FIG. 10.

Detailed Description Text (2):
The present invention provides a medical image management system (1) and method that, in one particular beneficial mode using the known "Internet" communications network, functions as an "Applications Service Provider" (ASP), which terms are herein intended to mean an information management service that is centrally accessible from various remote locations. The following are specific embodiments which are contemplated among the benefits associated with the ASP and other aspects of the invention:

Detailed Description Text (3):
1. Electronically deliver medical images in electronic record form to referring physicians, surgeons, radiologists, other healthcare providers, patients, and other interested authorized, parties outside of the imaging center, preferably via "push" technology.

Detailed Description Text (7):
The present invention will revolutionize the process of image delivery by use of a global broadband network that will connect imaging centers and hospital radiology departments with their radiologists and referring doctors. The invention provides immediate access to patient images, allowing the same diagnostic imaging information to be available at several locations immediately after completion of the procedure. Just as the fax machine completely changed the way doctors received imaging reports, (supplanting the US Postal Service, making the process faster and much more cost efficient), the present invention is believed to represent a similar revolution in the distribution of digital medical images. With the recent advent of broadband Internet connections, which by the end of 2001 will be available to the majority of the population in the form of Digital Subscriber Lines (DSL), continued adoption of this communication mode by the healthcare community will expand the significant transition in the way images are managed between remote locations according to the management system and method of the invention.

Detailed Description Text (8):
According to the invention as shown in FIG. 1, medical image management system (1) includes a medical imaging system (10), a local image workstation (20), a central data management system (30), and a remote image viewing system (40), which together provide an efficient, resource-effective, Internet-based ASP for the immediate electronic delivery and storage of medical images. In addition, an image history record system is also provided which allows for efficient tracking of when and where electronic records associated with images are transmitted, opened, and stored.

Detailed Description Text (9):
The overall system (1) of the invention is used in one general embodiment according to the following method, which is further shown in finer detail in flow-chart format in FIGS. 5A-D. A patient study or exam is conducted at a medical imaging center using medical imaging system (10) to obtain a set of images associated with a targeted region of a patient's body. These images are provided by the medical imaging system in an electronic form as electronic images (6) that are a part of an electronic record (5), as shown in FIG. 2 and further explained in detail below. The technologist performing the exam transfers the electronic record to local image workstation (20) which is also located onsite at the imaging center. The local image workstation (20) is shown in overview in FIG. 3 for the purpose of general illustration. Local image workstation (20) archives the data locally, and then

"pushes" (as explained in detail below) the electronic record to central data management system (30) at a remote location, as described in detail below.

Detailed Description Text (10):
If the imaging system (10) does not output the images packaged in the format Digital Imaging and Communications in Medicine (DICOM) compliant format, local image workstation (20) will convert the data into the DICOM format prior to transmission to central data management system (30) at a remote location with respect to the imaging, center. Once the electronic record (5) is received at central data management system (30), it is stored at that remote location and automatically routed., again via "push" delivery (described in more detail below), to one or more remote image viewing systems (40) at the respective radiologist, referring physician or surgeon, or other healthcare provider who is at another location remote from both the imaging clinic and the central data management system (30) locations. Where a radiologist is receiving electronic record (5) for viewing and interpretation/diagnosis, the radiologist in one aspect may produce a report containing new information that may be attached to the electronic record (5) and updated to the referring physician or surgeon. In addition, an image history record system (200) maintains an image history record with information regarding transmission and viewing records associated with the electronic record, and routes the respective information in the record back from these remote viewing stations, through the central data management system (30), and to the local image workstation (20) at the imaging center that produced the original image.

Detailed Description Text (11):
More detail of each component of this overall medical image management system as contemplated according to the invention is provided as follows.

Detailed Description Text (13):
As mentioned above, the present invention broadly contemplates use of a medical imaging system (10) that provides images in electronic form for electronic delivery. In particular, the invention is believed to be highly beneficial for providing a useful ASP for managing images associated with studies conducted on MRI and CT medical image systems. In addition, the invention also contemplates the following imaging modalities as suitable substitutes for medical image system for use according to the overall medical image management systems and methods of the invention: ultrasound, computed tomography, nuclear medicine, digital radiography, etc.

Detailed Description Text (16):
In one highly beneficial embodiment, local image workstation (20) uses direct capture (as described above) to acquire the electronic image data from the imaging system. This ensures that the exact digital data, as stored on the imaging system, both in terms of matrix size and pixel depth, is transferred to the system of the invention. A physician or other healthcare provider can window and level (control brightness and contrast) as well as zoom and measure pathology with this data set. The physician can also use reference images to know the exact location of the image inside the body. These features are generally not present with frame-grabbed images, which again represents the technique employed by some other known electronic medical image management systems. The other advantage of this direct capture is that the image quality on the receiving end is as good as it is on the shipping end, which means that the image quality is the same as the MRI or CT technologists performing the study sees on the computer.

Detailed Description Text (18):
Further, the ACR standard recommends that the DICOM standard be used. Most currently installed medical imaging systems do not output the digital data in the standard DICOM complaint format. Therefore, according to this aspect special interfaces may be required to accomplish "direct" capture by generally converting the non-DICOM record to the DICOM format. Such interface may be provided as a

separate DICOM workstation located between the local image workstation (20) and either the medical image system or the central data management system (30) that receives the output from the local image workstation (20). Or, the invention may also incorporate interfaces directly into the local image workstation (20) that enable the direct capture of data generated by many MRI systems, such as by providing a DICOM conversion technology within the architecture of local image workstation (20). One example of such a DICOM-converting interface is commercially available from Image Enhancement System, Inc. (IES), a California corporation, Another example of such an interface is commercially available by MERGE Technologies, located in Milwaukee, Wis. Interfaces to other imaging systems may also be used or otherwise developed and integrated in the overall system and methods of the invention so as to extend the reach of the invention to those imaging systems as well. Interfaces that may be developed for MRI, CT, and other radiological imaging devices are contemplated under the present invention.

Detailed Description Text (25):
It is believed that most other medical image management ASP efforts are intending to use PCs with a Microsoft database on their central servers. It is further believed that such a database will be inadequate in many circumstances, in particular when dealing with the massive storage required by imaging centers and hospitals. For this reason the present invention preferably incorporates more robust database platform, such as for example an Oracle database on a Unix platform. This will ensure a high level of reliability and scalability. The central storage system of the central data management system (30) takes into account the storage and access needs of imaging center and remote users. The rationale behind the architecture is that: most recently stored data is the most frequently accessed data and requires the most expedient retrieval; and as the data ages, the frequency of access and the need for expediency decreases.

Detailed Description Text (26):
The invention's storage system uses a hierarchical storage management (HSM) scheme to exploit the cost/benefit ratios of different storage technologies while realizing an optimum design to satisfy the above rationale. This architecture combines hard disks and tape devices, managed by intelligent software, to leverage the fast access and throughput performance benefits of disks with the cost benefits of tape media. Various aspects of the medical image storage system as provided by the present invention are presented in the following table, showing the different storage media used and the duration for which the data resides on each type of storage device along with approximate costs.

Detailed Description Text (34):
In contrast to other known efforts at providing a medical image management ASP, the present invention employs "push" delivery of medical images directly to the referring physician's office or offices, which may be completed according to the invention immediately after generating the image at the medical imaging center. The use of the push methodology directly addresses the needs of referring physicians prescribe the imaging study in order to diagnose or treat a patient. Clearly, these healthcare providers want the images delivered to their office(s) just as they have the films delivered today. With push delivery of electronic image records according to the invention, the image delivery will take place in the background and be on the physician's desktop computer ready for review whenever the doctor is ready to view them.

Detailed Description Text (35):
The push aspect of the invention saves costs directly equated with physician time, and is also believed to enable an increase in imaging center revenues. In one regard, referring physicians do not need to spend the time to log on to find and download the images, and in another regard medical imaging clinics that use the medical image management systems and methods of the invention will be able to use the connectivity of the overall system as a marketing advantage, attracting

referring doctors and their patients who can participate in the "push" image transmission stream.

Detailed Description Text (41):
Remote image viewing system (40) also preferably incorporates or interfaces with a database. This database in one beneficial mode is an extensive, queriable database so the physician can simply type in the patient's name or other identifying factors to bring up that particular patient immediately, even if there are hundreds of patients on the doctor's hard drive. The physicians will also be able to configure their patient image database on their computer in different ways in order to organize their patients the way they feel will be most efficient for them.

Detailed Description Text (42):
This flexibility differentiates the present invention from other medical image management ASPs that will only allow central storage of images at the company site. With the present invention, the image data, once the physician selects the patient, will be immediately downloaded into RAM on his or her computer. This allows the physician to have access quickly to the entire data set and allow for rapid change from image to image efficiently, thereby decreasing the time that the physician needs to review his patients' images. The physician will be able to view his or her patients' images even if the computer is off-line, such as when the doctor carries the laptop computer on rounds, or even to the operating room, All other known medical image management systems and methods are believed to require the physician to log on to web sites and then download the images to his computer. Hence, with other ASP systems not associated with the present invention, if the physician wishes to see his patients' images again, he must repeat the extensive and lengthy login and download procedures. It is believed that such methods which rely upon the physician to actively login and download, will be unacceptable for the referring doctors who are extremely busy and are used to images being delivered to them on film. Doctors will expect the same (image delivery to the doctor, not the doctor having, to actively seek their patient images) in the future with any digital image ASP.

Detailed Description Text (44):
Notwithstanding the significant benefits of the electronic image flow as herein shown and described, some parties will still invariably want medical images on hard-copy film. This may also be accomplished by use of the present system as shown in FIG. 1 by sending the electronic record to a film printer (50) that converts the electronic image of electronic record (5) into film image (5') for delivery to the interested party. Because the image is stored and managed centrally, film printers that exist locally to the intended delivery location may be sent the electronic record via remote interface, and may in fact even have themselves a remote image viewing system according to the invention, at least to the extent that it is configured to open the proprietary electronic records to access the film for printing.

Detailed Description Text (55):
Medical images are archived according to the invention in multiple locations according to a storage system (100) as follows.

Detailed Description Text (56):
All diagnostic studies are "medical records" and must be stored for a considerable period of time, generally for a minimum of seven years. The present invention provides a more efficient and less expensive solution for image storage, based on the Internet-based paradigm for the distribution and storage of medical images. More specifically, the invention utilizes a three-prong approach to the storage of the digital images: 1) at the remote image viewing systems (40) generally at the referring doctors' and radiologists' practice locations; 2) at two central servers associated with central data management system (30), and 3) at the local image workstations (20) located at transmitting imaging centers or hospitals. Therefore,

there will be four redundant, physically separate locations where the images are stored to ensure unsurpassed reliability and efficiency in accessing image data.

Detailed Description Text (59):
The invention according to another embodiment also provides for information associated with the transport, storage, viewing, analysis, and other management of a medical image to be efficiently communicated to all interested parties, herein referred to and shown in the Figures as image history record system (200)(FIGS. 1 and 5A-D).

Detailed Description Text (60):
In one aspect, medical image centers can track the entire process of image deliver storage and review from the local image workstation (20) merely by reference to the local image workstation (20) located in their respective clinic or hospital. More specifically, a local history record system (220) displays the image history on the local image workstation (20)'s monitor, and for example notifies the clinic of each successful delivery. Also, if a delivery attempt was unsuccessful (for instance the referring doctor's computer was turned off or the Internet access was down), the customer is notified so appropriate actions can be taken to assure a quick delivery. Thus healthcare providers using the system have a degree of image management that has never been possible before with film. Furthermore, when and where the images are reviewed by the radiologist or referring physician a message may be reflected on the local image workstation (20). None of the other medical image management features with their ASP.

Detailed Description Text (65):
One cost-flow embodiment of the invention charges a fixed monthly fee, in addition to waiving installation costs in certain DICOM enabled imaging centers. This is believed to be beneficial to imaging centers or small hospitals that would have to pay $100-300 thousand up front for a PACS type system and also would need extensive IT personnel support to keep the PACS operating. The cost of using the system of the invention according to this cost-flow method is less than the cost of just the IT person who would be needed for a PACS. Moreover, PACS systems do not address the issue most important to the imaging centers: delivering the images to the referring doctors quickly and reliably. In addition, the present invention does not require the cost for secondary capture equipment and a DICOM sending station that other known medical image ASP services are believed to require. Picture Archiving and Communication Systems (PACS) generally cost $60,000 to $1,000,000, and include associated inefficiencies and costs of additional personnel to run the sophisticated hardware. According, to this invention, a monthly fee, for example of approximately $4,000 or $48,000 annually, may be charged for high performance electronic delivery, storage, retrieval, and display of the digital images. In one embodiment, this is the only fee charged, independent of volume of use. According to another embodiment, a per use fee may also be charged. In either case, the ASP-related fees represent a considerable cost savings to the clinic or hospital when compared to either use of a PACS or the current use of film. The invention therefore helps imaging centers and hospital radiology departments maximize their productivity while minimizing their costs.

Detailed Description Text (67):
FIGS. 8 and 10 illustrate a polling system of an Alternative Embodiment. FIGS. 7 and 9 illustrate a variation of the present invention in which the medical image management system includes at least one polling system 400 as illustrated in FIG. 10. FIG. 9 illustrates a medical image management system similar to the system illustrated in FIG. 1 with like numerals representing the same elements with the corresponding description herein. The system of FIG. 9 additionally includes a polling system 400 located with each of the local image workstation 20 the remote image viewing systems 40. The polling systems 400 each communicate with the central data management system 330. The central data management system 330 further includes a delivery queue 231 that holds data for which attempted delivery has failed. Each

set of data queued for delivery in the data queue 231 includes an identifier that associates the particular set of data with the intended delivery location. The identifier may also associate that data with its origin and/or its corresponding location in the central storage system 130. The central data management system 330 also comprises a look up table 232 that stores the last known IP address for each local or remote workstation, viewer or system. Finally, the central data management system 330 includes a delivery status database 233 that tracks the delivery status of all data including information relating to delivery attempts, successes and failures. In an alternative arrangement, this information may be stored with the data itself.

Current US Original Classification (1):
707/201

Current US Cross Reference Classification (3):
707/10

Current US Cross Reference Classification (4):
707/104.1

Current US Cross Reference Classification (5):
707/2

Current US Cross Reference Classification (6):
707/3

CLAIMS:

1. A medical image management system comprising: a central data management system which is adapted to receive and store an electronic record from a medical imaging device; and a remote image viewing system arranged to receive the electronic record and to display the record in a visible format, said central data management system and said remote image viewing system being in communication along a remote interface; wherein said central data management system is configured to push the electronic record to the remote image viewing system and to store the electronic record in a queue if the central data management system fails to push the electronic record; and wherein said remote image viewing system comprises a polling system including an internal poller to identify when an event has occurred, and a data requestor in communication with said central data management system to request queued data when said event has occurred.

14. A medical image management system comprising: a central data management system which is adapted to receive and store an electronic record from a medical imaging device; and a remote image viewing system arranged to receive the electronic record and to display the record in a visible format, said central data management system and said remote image viewing system communicating along a remote interface; wherein said central data management system comprises an IP address look up table including a last known IP address associated with a remote image viewing system and wherein said central data management system is configured to push the electronic record to the remote image viewing system at said last known IP address and wherein said remote image viewing system comprises a polling system including a internal poller to identify when an event has occurred and an IP address notifier in communication with said central data management system to notify said central data management system of the current IP address of the remote image viewing system when said event has occurred.

15. The medical image management system of claim 14 wherein said event is the booting of the remote image viewing system.

16. The medical image management system of claim 14 wherein said event is

establishing an internet connection.

17. The medical image management system of claim 14 wherein said event is a change in IP address.

26. A medical image management system comprising: a medical imaging means at a first location for producing an electronic record in a computer-readable format and that includes an electronic image associated with a region of a patient's body; a storage means for storing the electronic record; a pushing means for pushing the electronic record along a remote interface to a remote image viewing system at a second location that is remote from the first location, wherein the electronic record is pushed in a format that may be opened such that the electronic image may be converted into a recognizable, visible format; a queue means for temporarily storing an electronic record when it has not been successfully pushed to the remote image viewing system; and a polling means at said remote image viewing system for requesting an electronic record stored in said queue means when a predetermined event has occurred.

27. A medical image management system comprising: a medical imaging means at a first location for producing an electronic record in a computer-readable format and that includes an electronic image associated with a region of a patient's body; a storage means for storing the electronic record; a pushing means for pushing the electronic record along a remote interface to a remote image viewing system at a second location that is remote from the first location, wherein the electronic record is pushed in a format that may be opened such that the electronic image may be converted into a recognizable, visible format; an IP address look up means for storing a most recent know IP address corresponding to a remote image viewing system; a polling means at said remote image viewing system for updating the IP address look up means when a predetermined event has occurred.

28. A method for managing medical images, comprising: receiving along a first remote interface at a central data management system, an electronic record from a medical imaging system located at a first location, wherein the central data management system is located at a second location that is remote from the first location, and wherein the electronic record includes an electronic image that is associated with a body of a patient; and pushing the electronic record along a second remote interface to a remote image viewing system located at a third location that is remote from the first and second locations; storing an electronic record in a temporary location when the electronic record has not been successfully pushed; requesting the temporarily stored electronic record by the remote image viewing system upon the occurrence of a predetermined event.

31. A method for managing medical images, comprising: storing the IP address of a remote location in a look up table in a central data management system at a second location; receiving along a first remote interface at the central data management system, an electronic record from a medical imaging system located at a first location, wherein the central data management system is located at the second location that is remote from the first location, and wherein the electronic record includes an electronic image that is associated with a body of a patient; and pushing the electronic record from the central data management system along a second remote interface to a remote image viewing system located at the remote location that is remote from the first and second locations; checking the IP address at the remote image viewing system upon the occurrence of a predetermined event and if the IP address has changed, communicating the changed IP address to the central data management system; and updating the look up table with the changed IP address.

34. A medical image management system comprising: a central data system which is adapted to receive and store an electronic record from a medical imaging device; a remote image viewing system arranged to receive the electronic record; and a remote

interface between said central data system and said remote image viewing system, wherein said central data system and said remote image viewing system are in communication along said interface, said remote image viewing system including a polling system comprising an internal poller to identify when an event has occurred and a data requestor in communication with said central data management system to request queued data when said event has occurred.

L9: Entry 18 of 20 File: USPT Sep 7, 1999

DOCUMENT-IDENTIFIER: US 5950207 A
TITLE: Computer based multimedia medical database management system and user interface

Brief Summary Text (9):
Hard copy analysis and archiving systems are often employed even where the original data is in digital form. Medical facilities often generate and maintain medical images, patient information, and diagnostic reports in a digital format, but present the information to the user as hard copies. Similarly, images generated by digital imaging techniques, such as ultrasound, nuclear medicine, digital fluorography or angiography, computerized tomography ("CT"), magnetic resonance ("MR"), and computerized radiography, are initially generated in digital form, then transferred to a hard copy for presentation to the radiologist or clinician. The hard copy is easier than the digital data for the analyst to access, handle, and visualize. The digital data, on the other hand, is often discarded immediately or shortly after creation; alternatively, the original digital data may be maintained only as a backup to replace lost or damaged hard copies, while the hard copies are traditionally used for analysis and long-term archiving.

Brief Summary Text (13):
According to various aspects of the present invention, a computer database system for managing multimedia medical images, e.g. both hard copy (paper and film) and electronically stored images and data, automatically assigns a unique identifier to each data object. The system may further assign an identifier to groups of associated data objects. The identifier is preferably assigned when the data object is generated, and may be encoded into a machine-readable representation which is suitably printed on all hard copies of the associated image. With an appropriate reading device, a user may scan the representation which uniquely identifies the associated data object within the database.

Detailed Description Text (5):
If a data source does not generate the data in an appropriate format, the output may be converted to, accommodated by, or referenced by the selected standard file structure. For example, a data source may generate an output in another format, such as a different digital format or an analog format. In that case, the output may be digitized, if necessary, and converted to the appropriate file structure by a suitable external interface device 35, such as a commercially available Merge Technologies Merge MVP.TM. interface.

Detailed Description Text (6):
Various data sources, such as ultrasound (US) device 30, may create images in video (i.e. non-digital) or similar formats. Such data may be temporarily stored in a suitable memory until the data is to be digitized and formatted according to the standard file structure. For example, the images generated by US device 30 may be provided to a video image storage system 37. Video image storage system 37 suitably comprises a video disk or video tape system for recording the video images generated by US device 30 until the images are accessed by server 20. Images retrieved from video image storage system 37 may be digitized by a digitizer 39, converted to the standard file structure by server 20, and stored and modified by server 20 as they are needed.

Detailed Description Text (7):
The data generated by data sources 24, 26, and 28 is shown passing through respective external interface devices 35 to put the data in an appropriate file structure. Alternatively, the non-digital data from MR data source 24 may be digitized by a digitizer (not shown), and the digital data from data sources 24, 26, 28 and 30 (after digitization by digitizer 39) may be converted to an appropriate file structure by server 20.

Detailed Description Text (8):
Data may also be generated directly from hard copies using scanner 33 to provide electronic data representative of the corresponding images and text. Scanned data may then, if necessary, be converted to the appropriate format and assigned a unique identifier as required by the database by either scanner 33 or server 20. Data with an embedded identifier may also be read from film or paper using scanner 33, with the resultant data and unique identifier being compiled into the format required by the database.

Detailed Description Text (19):
In particular, referring to FIG. 3, the memory of server 20 suitably comprises: an image buffer 301; a process queue 302, a process queue bottom pointer 303A, and a process queue top pointer 303B; a database directory 304; a designated image pointer 306; a generated bit map array 308; a detected bit map array 310; a set selection array 312; a next identifier pointer 318; a display buffer 320; and an image database array 325. It should be noted that FIG. 3 illustrates only the various names for designated portions of the memory. FIG. 3 does not represent a memory map of the present system, but simply lists various items included in the memory system.

Detailed Description Text (22):
Data in process queue 302 at the location indicated by queue top pointer 303B may be forwarded to display buffer 320. Display buffer 320 suitably comprises an array of contiguous memory locations containing display data received from process queue 302. Server 20 suitably extracts the identifier associated with the data in display buffer 320 from the data object, encodes the identifier according to a predetermined algorithm (as described further below), and converts the result into pixel values which constitute indicia or a representation of the identifier. The representation suitably comprises a three-dimensional array (X, Y, Z, where X and Y are spatial coordinates and Z is, e.g., a gray scale value). The encoding algorithm preferably generates a machine readable representation that is readable by a reading device (e.g. detector 40) regardless of the orientation between the representation and the reading device. In addition, the encoding algorithm suitably provides sufficient resolution for error checking and for encoding all of the information in the identifier.

Detailed Description Text (25):
Generated bit map array 308 stores the converted pixel values for the identifier. Generated bit map array 308 suitably includes an array of contiguous memory locations, such as in RAM. Data in display buffer 320 is suitably modified to integrate the representation of the identifier in generated bit map array 308 into the data in display buffer 320.

Detailed Description Text (26):
After modification to integrate the identifier representation, data in display buffer 320 is suitably transferred to image database array 325. Image database array 325 stores not only images, but text and other relevant information as well. Image database array 325 suitably comprises the main memory for data generated, maintained, and accessible by the system. Because of the extremely large number of data objects likely to be stored in the system, image database array 325 suitably includes a mass storage system, such as a tape drive, optical drive, or hard drive

array.

Detailed Description Text (27):
The identifier for each image stored in image database array 325 and video image storage 37 is stored in database directory 304. Database directory 304 suitably comprises a series of contiguous memory locations, also suitably in mass storage such as a hard drive array, preferably at least equal in number to the maximum number of images to be stored in image database array 325 and video image storage 37. Database directory 304 preferably contains one identifier for each image and set of images stored.

Detailed Description Text (28):
Detected bit map array 310 suitably receives data from detector 40. Detected bit map array 310 suitably comprises an array of contiguous memory locations of similar size and configuration as generated bit map array 308. As described in detail below, detector 40 suitably detects the representation of the identifier associated with a data object embedded in a hard copy. The digital signal from detector 40 suitably accumulates in bit-mapped three-dimensional detected bit map array 310. Detected bit map array 310 stores the pixel data for decoding by server 20 to generate the identifier associated with the data, thus enabling server 20 to selectively retrieve data from image database array 325 or video image storage 37.

Detailed Description Text (30):
Finally, designated image pointer 306 suitably comprises a register containing the memory location of an image in image database array 325 or in video image storage 37 to be transmitted to a remote device. For example, an operator (remote or local) may select an image to be transmitted using the corresponding identifier. Server 20 suitably loads the selected unique identifier from database directory 304 and writes a value corresponding to the appropriate memory location to designated image pointer 306. Server 20 retrieves the designated data object from the location in image database array 325 or video image storage 37 pointed to by designated image pointer 306, and transmits the selected image to the operator's station.

Detailed Description Text (32):
Referring to FIG. 4, after a data object is generated by a data source, converted to the appropriate format, and preferably assigned an identifier, the data object may be transmitted, suitably through network 31, to server 20 (step 410). The data suitably accumulates in image buffer 301 (step 412), and may then be written into process queue 302 at a location designated by queue bottom pointer 303A (step 414).

Detailed Description Text (35):
The identifier may be written into database directory 304 (step 422), and the modified image data (the "tagged data object") is suitably written to image database array 325. If more data objects remain in process queue 302, queue top pointer 303B may be then adjusted to advance the process to the next data object in process queue 302 (step 424), and the next data is retrieved from process queue 302.

Detailed Description Text (40):
The digital signal received by server 20 from detector 40 is suitably accumulated in bit-mapped three-dimensional (X,Y,Z) detected bit map array 310, representing a precise digital image of the original representation 42. The bit-mapped version of representation 42 is then suitably decoded employing the converse of the predetermined encoding algorithm to produce the original unique identifier. The identifier may be used, in conjunction with directory 304, to identify the locations in image database array 325 or video image storage 37 where the data object corresponding to the hard copy is stored, and for selectively retrieving information relating to the designated hard copy image or set of images. This allows the operator to access any data previously stored with respect to image 36

or related images, e.g. a treating physician wanting to examine images in addition to those provided by the radiologist.

Detailed Description Text (47):
The particular images to form the set may be designated using detector 40, and the corresponding identifiers are suitably written into set selection array 312 (step 608). When the images are viewed in hard copy form, detector 40 may be employed to read embedded representation 42 in the images, and the identifiers may be derived according to the previously described decoding process. After all members of the set have been designated, the set data object is modified to include the images in set selection array 312 (step 610). The set identifier is then written to database directory 304 (step 612), and the resultant set data object is stored in image database array 325 (step 614). For example, the entire set of data may be collected into a single object, assigned an identifier, and provided with the appropriate encoded representation. Therefore, each time the set is designated for display, the machine readable representation associated with the set is generated on the hard copy sheet in a predetermined relationship to the images which is readily discernible to the user, e.g. in the margin next to each image, or on each sheet of hard copy representing the set.

Detailed Description Text (48):
Referring again to FIG. 1, server 20 may further transmit designated data objects to remote servers (or other stations such as displays, hard copy generators, etc.) through network 31. As described above, network 31 suitably comprises a communications network such as a 10-base T local area network (LAN) employing twisted pair cables. Network 31 suitably communicates with a remote server 52 or remote display device 54. For example, referring to FIG. 8, data may be transmitted to a remote location by first establishing a connection between server 20 and a remote device, such as remote server 52 or remote display 54 (step 800). This connection may be initiated by either server 20 or the remote device 52, 54. The operator may then select which data object is to be transmitted (step 802) by providing the appropriate identifier or other suitable information. Server 20 then suitably reads the selected identifier from database directory 304 (step 804), and writes this value to designated image pointer 306 (step 806). Server 20 may retrieve the designated data object from the location in image database array 325 or video image storage 37 pointed to by designated image pointer 306, and store this data object in image buffer 301 (step 808). Server 20 then suitably transmits the selected data object in image buffer 301 to the remote device (step 810).

Detailed Description Text (49):
The ability to selectively designate images for transmission to points of care is particularly significant in view of the finite bandwidth and transmission speeds of network 31. In a fully interactive system, server 20 would also respond to commands from a remote server to send frames as required for viewing on an electronic viewing station or for printing only the selected images on a hard copy output device, such as laser imager 32. This configuration may permit an operator at a remote site with remote server 52 to examine the images stored in image database array 325 and in video image storage 37, and to edit the images in the same way as the local operator.

Current US Original Classification (1):
707/104.1

Current US Cross Reference Classification (1):
707/100

CLAIMS:

35. A management system for multimedia information comprising:

a plurality of information generating devices generating data objects in a plurality of formats;

a converter connected to at least one of the information generating devices for converting information into a format compatible with the formats of data objects generated by other information generating devices;

an indexer for assigning a unique identifier to each data object generated by the information generating devices; and

a hard copy generator for generating a hard copy of the information based on at least one of the data objects, wherein the hard copy generator automatically integrates a machine readable representation of the corresponding unique identifier into the hard copy.

39. The management system of claim 35, wherein:

the converter generates a second data object related to the first data object; and

the indexer assigns a second unique identifier to the second data object, wherein the second unique identifier is related to the first unique identifier for correlation of the first and second data objects.

41. The management system of claim 35, wherein the converter generates a second data object, and the management system further comprises an editor for selecting portions of the first data object and the second data object to create a third data object comprising at least one of the selected portions.

46. The management system of claim 45, further comprising a second converter connected to the scanner for converting data from the scanner into a format compatible with the formats of data objects generated by other information generating devices.

56. A management system for multimedia information comprising:

a plurality of information generating devices generating data objects in a plurality of formats;

a converter connected to at least one of the information generating devices for converting information into a format compatible with the formats of data objects generated by other information generating devices;

at least one generated data object including textual and pixel data components;

an indexer for assigning a first unique identifier to the pixel data component and a second unique identifier to the textual data component, wherein the second unique identifier is related to the first unique identifier to facilitate correlation of the textual data component to the pixel data component; and

a hard copy generator for generating a hard copy of the information based on at least one of the data objects, wherein the hard copy generator automatically integrates a machine readable representation of the corresponding unique identifier into the hard copy.

59. The management system of claim 58, wherein at least one of the indexers includes a converter for converting data objects generated by the corresponding data generating device into a format compatible with each of the other data objects.

69. The management system of claim 68, further comprising a converter connected to

the scanner for converting data from the scanner into a format compatible with the formats of data objects generated by other data generating devices.

L9: Entry 17 of 20 File: USPT Jul 31, 2001

DOCUMENT-IDENTIFIER: US 6269379 B1
TITLE: Medical image filing system enabling registration and retrieval of a plurality of medical images

Abstract Text (1):
In an image filing system in accordance with the present invention, image files containing images that should be displayed on a viewing monitor in a conference unit are selected from among retrieved image files using a mouse. A CPU determines how many image files are selected using the mouse and identifies management information contained in the selected image files. Under the control of the CPU, images in a work memory are temporarily stored in an image processor. The images in the image processor are displayed on a retrieval monitor. Management information contained in the selected image files and the number of selected image files are supplied from the CPU to a controller over a bus. Reduced images provided in the form of digital data and contained in the selected image files in the image processor are supplied to a D/A converter under the control of the controller. The D/A converter de-quantizes the digital data into analog data so as to display the reduced images on the viewing monitor.

Brief Summary Text (3):
The present invention relates to a medical image filing system in which a plurality of medical images are registered or retrieved on or from a medical image database for use in managing numerous images acquired by an endoscope system, diagnostic ultrasound system, or the like.

Brief Summary Text (8):
On the other hand, proposals have been made for an image display unit based on a medical image database that is useful for managing numerous images produced by the endoscope system, diagnostic ultrasound system, or the like.

Brief Summary Text (15):
An object of the present invention is to provide a medical image filing system enabling reference of a plurality of images contained in image files retrieved according to a plurality of retrieval information items and thus realizing close diagnosis.

Brief Summary Text (16):
Another object of the present invention is to provide a medical image filing system making it possible to distinguish a plurality of displayed reduced images according to management information.

Brief Summary Text (17):
Yet another object of the present invention is to provide a medical image filing system that even when the number of reduced images contained in an image file exceeds the number of reduced images to be displayed, enables reference of all the reduced images in the image file.

Brief Summary Text (18):
Still another object of the present invention is to provide a medical image filing system capable of guaranteeing safety of application and other programs to be run.

Brief Summary Text (19):
A medical image filing system in accordance with the present invention comprises an image input means for inputting an image in the form of image data, a file creating means for creating an image file using at least one image and management information concerning the image, a file storage means for storing image files, a file retrieving means for retrieving image files from the file storage means according to the management information, a selecting means for selecting any of the image files retrieved according to the management information by the file retrieving means, and a display means for fetching images from the image files retrieved the data storage means and then selected by the selecting means and displaying them.

Detailed Description Text (3):
As shown in FIG. 1, an image filing system 1 of an embodiment in accordance with the present invention comprises a video processor 2 for fetching an image signal from, for example, an electronic endoscope that is not shown and converting it into a video signal, a viewing monitor 3 for rendering the video signal sent from the video processor 2, an input unit 4 for converting the video signal sent from the video processor 2 into an image and performing signal processing on the image, a server unit 5 for storing the image subjected to signal processing by the input unit 4 and compressed an image produced by compressing the image on a reversible or non-reversible basis, and a conference unit 6 for retrieving and displaying the image or compressed image stored in the server unit 5.

Detailed Description Text (4):
The input unit 4 consists of an A/D converter 11 (image input means) for converting R, G, and B analog video signals, which constitute a video signal sent from the video processor 2, into digital signals representing an image, an image processor 12 (file creating means) having a memory for storing images and creating an image file containing management information sent from the video processor 2, a local area network (hereinafter LAN) controller 13 for transmitting an image file created by the image processor 12 to the server unit 5 over a LAN cable 4a, and a controller 14 for transferring management information concerning an image to or from the video processor 2 and controlling the image processor 12 and LAN controller 13.

Detailed Description Text (5):
The video processor 2 has a video signal output terminal, R, G, and B analog video signal output terminals, and a communication signal output terminal. The video signal output terminal is connected to the viewing monitor 3, the R, G, and B analog video signal output terminals are connected to an input terminal of the A/D converter 11, and the communication signal output terminal is connected to the controller 14.

Detailed Description Text (6):
An output terminal of the A/D converter 11 is connected to a data signal terminal of the image processor 12.

Detailed Description Text (8):
A view provided by, for example, an electronic endoscope that is not shown and converted into a video signal by the video processor 2 is rendered as a view image to be displayed on the viewing monitor 3. When an operator of the video processor 2 determines that the view image should be stored, the video signal is provided in the form of R, G, and B analog video signals to the A/D converter 11. The A/D converter 11 converts the R, G, and B analog video signals into R, G, and B digital video signals by performing given quantization, and supplied them as image data representing a view image to the image processor 12.

Detailed Description Text (9):

The image processor 12 stores the view image supplied from the A/D converter 11 under the control of the controller 14.

Detailed Description Text (15):
The conference unit 6 consists of a LAN controller 31 for receiving an image file or compressed image from the LAN controller 21 in the server unit 5 over a LAN cable 5a, an image processor 32 (data memory means) for storing the image file or compressed image received by the LAN controller 31, a stretcher 33 for stretching the compressed image stored in the image processor 32, a D/A converter 34 for converting an image represented by digital signals and contained in the image file stored in the image processor 32 and the image stretched by the stretcher 33 into R, G, and B analog video signals by performing de-quantization, a viewing monitor 35 (display means) for rendering the R, G, and B analog video signals provided by the D/A converter 34, and a controller 36 for controlling the image processor 32.

Detailed Description Text (16):
A data signal terminal of the image processor 32 is connected to an input terminal of the D/A converter 34. An output terminal of the D/A converter 34 is connected to the viewing monitor 35. A control signal terminal and data signal terminal of the controller 36 are connected to control signal terminals of the image processor 32 and LAN controller 31 over a bus 36a. The control signal terminal and data signal terminal of the controller 36 are connected to a control signal terminal of a CPU 41, which will be described later, over a bus 36b.

Detailed Description Text (26):
The image processor 32 stores the view image. The view image stored in the form of digital signals in the image processor 32 is converted into R, G, and B analog video signals by the D/A converter 34 through de-quantization, and then supplied to the viewing monitor 35. The viewing monitor 35 renders the supplied R, G, and B analog video signals. When the view image is a compressed image, the view image is stretched by the stretcher 33 and then supplied to the D/A converter 34.

Detailed Description Text (49):
A view provided by, for example, an electronic endoscope and converted into a video signal by the video processor 2 is rendered as a view image through the viewing monitor 3. When an operator of the video processor 2 determines that the view image should be recorded, the view image is supplied in the form of R, G, and B analog video signals to the A/D converter 11, converted into R, G, and B digital video signals by the A/D converter 11, supplied in the form of view image data to the image processor 12, and then stored in the image processor 12.

Detailed Description Text (55):
The controller 14 performs computation to convert the view image stored in the image processor 12 into reduced images. Management information is appended to the view image and reduced images, thus creating an image file. The image file is temporarily stored in the image processor 12 or supplied to the LAN controller 13. At step S26, the created image file is sent from the LAN controller 13 to the LAN controller 21 in the server unit 5 over the LAN cable 4a. The sequence terminates at step S27.

Detailed Description Text (68):
At step S48, the management information placed in the work memory 49 is transferred to the image processor 50 under the control of the CPU 41. The image processor 50 runs a program to convert the whole or part of the management information into a screen, and displays the screen on the retrieval monitor 44. Retrieval terminals at step S49.

Detailed Description Text (75):
At step S66, S67, S68, or S69, the management information in the selected image files and the number of selected image files are sent to the controller 36 over the

bus 36b. Under the control of the controller 36, reduced images provided in the form of digital data and contained in selected image files in the image processor 32 are supplied to the D/A converter 34. The D/A converter 35 de-quantizes the digital data representing the reduced images to produce analog data, and supplies the analog data to the viewing monitor 35 so that the reduced images can be displayed on the viewing monitor 35. At step S70, reduced image display terminates.

Detailed Description Text (91):
A view image that is provided in the form of digital data by the A/D converter 11 in the input unit in FIG. 1 may be compressed using a DCT or DPCM technique by the image processor 12. In this case, the image processor 32 in the conference unit 6 uses the stretcher 33 to stretch the compressed view image through de-DCT or de-DPCM.

Current US Original Classification (1):
707/104.1

CLAIMS:

1. A method of managing medical image files, comprising:

an image input step at which image data is inputted;

an image file creating step at which an image file is created by having the image data inputted at said image input step, management information for specifying the image data and reduced image data of said image data respectively be related to one another;

a file storage step at which at least one image file created at said image file creating step is stored in a file storage means;

a retrieving condition input step at which a predetermined retrieving condition to specify desired image data among the image data stored as the image file in said file storage means is inputted;

a retrieving step at which respective management information of the image file stored in said file storage means is retrieved in accordance with the retrieving condition inputted at said retrieving condition input step, and at least one image file is specified based on each of at least one management information which meets said retrieving condition;

a first display control step at which reduced images as many as possible to be displayed in a display area of a display means are displayed on the display means based on the reduced image data of the image file specified at said retrieving step;

a management information display instruction step at which display instruction is given for displaying at least one management information related to the reduced image displayed on the display means at said first display control step;

a management information display instruction reception step at which said display instruction at said management information display instruction step is received when the reduced image based on said reduced image data is displayed on the display means by said first display control step;

a second display control step at which at least one management information instructed to be displayed at said management information display instruction step is displayed on a display means when said display instruction is received at said management information display instruction reception step;

a scrolling instruction step at which instruction is given to perform a scrolling to display reduced image, which is related to the reduced image displayed on the display means by said first display control step but not displayed on the display means on the display means; and

a scrolling step at which a scrolling is performed to display the reduced image which is related to the reduced image displayed on the display means by said first display control step but not displayed on the display means, on the display means upon scrolling display instruction by said scrolling instruction means.

2. A method of managing medical image files according to claim 1, further comprising:

a selecting step at which any desired management information of the management information displayed on the display means at said second display control step is selected; and

an editing step at which the management information selected at said selecting step is edited.

3. A method of managing medical image files, comprising:

an image input step at which image data is inputted;

an image file creating step at which an image file is created by having the image data inputted at said image input step, management information for specifying the image data and reduced image data of said image data respectively be related to one another;

a file storage step at which at least one image file created at said image file creating step is stored in a file storage means;

a retrieving condition input step at which a predetermined retrieving condition to specify desired image data among the image data stored as the image file in said file storage means is inputted;

a retrieving step at which respective management information of the image file stored in said file storage means is retrieved in accordance with the retrieving condition inputted at said retrieving condition input step, and at least one image tile is specified based on each of at least one management information which meets said retrieving condition;

a first display control step at which at least one reduced image is displayed on a display means based on the reduced image data of the image file specified at said retrieving step;

a management information display instruction step at which display instruction is given for displaying at least one management information related to the reduced image displayed on the display means by said first display control step;

a management information display instruction reception step at which said display instruction at said management information display instruction step is received when the reduced image based on said reduced image data is displayed on the display means by said first display control step; and

a second display control step at which at least one management information instructed to be displayed at said management information display instruction step is displayed on the display means when said display instruction is received at said management information display instruction reception step.

4. A method of managing medical image files according to claim 3, further comprising a data memory step at which at least images contained in said image files retrieved at said file retrieval step are temporarily stored.

5. A method of managing medical image files according to claim 3 or 4, further comprising a display control step at which a screen provided at said display step is controlled according to the number of image files selected at said selection step.

6. A method of managing medical image files according to claim 3 or 4, wherein said image is an endoscopic image.

7. A method of managing medical image files according to claim 3, further comprising:

a selecting step at which any desired management information of the management information displayed on the display means at said second display control step is selected; and

an editing step at which the management information selected at said selecting step is edited.

8. A medical image file system, comprising;

an image input means for inputting image data;

an image file creating means for creating an image file by having the image data inputted by said image input means, management information for specifying said image data and reduced image data of said image data respectively be related to one another;

a file storage means for storing at least one image file created by said image file creating means;

a retrieving condition input means for inputting a predetermined retrieving condition to specify desired image data among the image data stored as the image file in said file storage means;

a retrieving means for retrieving respective management information of the image file stored in said file storage means in accordance with the retrieving condition inputted by said retrieving condition input means and specifying at least one image file based on each of at least one management information which meets said retrieving condition;

a first display control means for displaying reduced images as many as possible to be displayed in a display area of a display means on the display means based on the reduced image data of the image file specified by said retrieving means;

a management information display instruction means for instructing to display at least one management information related to the reduced image displayed by said first display control means on the display means;

a management information display instruction reception means for receiving said display instruction from said management information display instruction means when the reduced image based on said reduced image data is displayed on the display means by said first display control means;

a second display control means for displaying at least one management information instructed to be displayed by said management information display instruction means

on the display means when said display instruction is received by said management information display instruction reception means;

a scrolling instruction means for instructing to perform a scrolling to display reduced image, which is related to the reduced image displayed on the display means by said first display control means but not displayed on the display means on the display means; and

a scrolling means for performing a scrolling to display the reduced image, which is related to the reduced image displayed on the display means by said first display control means but not displayed on the display means on the display means upon scrolling display instruction by sad scrolling instruction means.

9. A medical image filing system according to claim 8, further comprising:

a selecting means for selecting any desired management information of the management information displayed on the display means by said second display control means; and

an editing means for editing the management information selected by said selecting means.

10. A medical image filing system, comprising:

an image input means for inputting image data;

an image file creating means for creating an image file by having the image data inputted by said image input means, management information for specifying the image data and reduced image data of said image data respectively be related to one another;

a file storage means for storing at least one image file created by said image file creating means;

a retrieving condition input means for inputting a predetermined retrieving condition to specify desired image data among the image data stored as the image file in said file storage means;

a retrieving means for retrieving respective management information of the image file stored in said file storage means in accordance with the retrieving condition inputted by said retrieving condition input means and specifying at least one image file based on each of at least one management information which meets said retrieving condition;

a first display control means for displaying at least one reduced image on a display means based on the reduced image data of the image file specified by said retrieving means;

a management information display instruction means for instructing to display at least one management information related to the reduced image displayed on the display means by said first display control means on the display means;

a management information display instruction reception means for receiving said display instruction from said management information display instruction means when the reduced image based on said reduced image data is displayed on the display means by said first display control means; and

a second display control means for displaying on the display means at least one management information instructed to be displayed by said management information display instruction means when said display instruction is received by said

management information display instruction reception means.

11. A medical image filing system according to claim 10, further comprising a data memory means for temporarily storing at least said images fetched from said image files retrieved by said file retrieving means.

12. A medical image filing system according to claim 10, further comprising a display control means for controlling said display means according to the number of image files selected by said selecting means.

13. A medical image filing system according to claim 12, further comprising:

a password input means for inputting a password;

a password memory means for storing said password;

a password supervising means for supervising said password stored in said password memory means; and

a control means for controlling said retrieving means according to a result of supervision made by said password supervising means.

14. A medical image filing system according to claim 12 further comprising:

a keyhole means into which a key is fitted in order to close a lock;

a key and lock supervising means for supervising the state in which said lock is closed with said key; and

a control means for controlling said retrieving means according to a result of supervision made by said key and lock supervising means.

15. A medical image filing system according to claim 12, further comprising:

an image compressing means for compressing said image file on a reversible or non-reversible basis so as to produce a compressed image file; and

an image stretching means for stretching said compressed image file;

said file storage means storing a compressed image file, and said display means displaying an image contained in said compressed image file stretched by said image stretching means.

16. A medical image filing system according to claim 12, wherein said image is an endoscopic image.

17. A medical image filing system according to claim 10, further comprising an information display means for displaying said management information concerning said plurality of reduced images displayed by said display means at a position associated with the position at which said plurality of reduced images are displayed.

18. A medical image filing system according to claim 17, further comprising a reduced image selecting means that when the number of reduced images contained in each image file exceeds the number of reduced images which can be displayed by said display means, modifies said management information to be displayed by said information display means and selects reduced images to be displayed by said display means.

19. A medical image filing system according to claim 10 or 11, further comprising:

a password input means for inputting a password;

a password memory means for storing said password;

a password supervising means for supervising said password stored in said password memory means; and

a control means for controlling said retrieving means according to a result of supervision made by said password supervising means.

20. A medical image filing system according to claim 10 or 11, further comprising:

a keyhole means into which a key is fitted in order to close a lock;

a key and lock supervising means for supervising the state in which said lock is closed with said key; and

a control means for controlling said retrieving means according to a result of supervision made by said key and lock supervising means.

21. A medical image filing system according to claim 10 or 11 further comprising:

an image compressing means for compressing said image file on a reversible or non-reversible basis so as to produce a compressed image file; and

an image stretching means for stretching said compressed image file;

said file storage means storing a compressed image file, and said display means displaying an image contained in said compressed image file stretched by said image stretching means.

22. A medical image filing system according to claim 10 or 11, wherein said image is an endoscopic image.

23. A medical image filing system according to claim 10, further comprising:

a selecting means for selecting any desired management information of the management information displayed on the display means by said second display control means; and

an editing means for editing the management information selected by said selecting means.